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Cover Photographs

Upper - Disquised as a snow patch or sitting on one, the mountain goat, *Oreamnos americanus*, is a quintessential component of the high mountain reaches on northwestern North America. This picture was taken in Olympic National Park, where the species has been introduced and may be detrimentally affecting some endemic plants.

Lower - The Olympic marmot, *Marmota olympus*, one of the six North American members of the genus, is endemic to the Olympic Mountains of Washington. These species and many others are discussed in the Smithsonian Book of North American Mammals, a recent book reviewed in this issue.

Photo Credit George Folkerts

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CONTENTS

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RECENT FRESHWATER MUSSEL (BIVALVIA: UNIONACEA) RECORDS FROM THE NORTH RIVER SYSTEM, FAYETTE AND TUSCALOOSA COUNTIES, ALABAMA

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ABSTRACT

Collections of freshwater mussels (Bivalvia: Unionacea) at 30 stations in the North River system of Fayette and Tuscaloosa Counties, Alabama from 1991-96 yielded 14 species and the Asian clam, *Corbicula fluminea* (Müller 1774). Eight species were collected alive, five were represented by fresh dead material, and one by a single weathered shell. Two species later receiving federal protection, the dark pigtoe, *Pleurobema furvum* (Conrad 1834), and the orange-nacre mucket, *Lampsilis perovalis* (Conrad 1834), were collected. Another protected species previously reported from the North River system, the triangular kidneyshell, *Ptychobranchus greenii* (Conrad 1834), was not collected, nor was *Pleurobema hagleri* (Frierson 1900), a species known from the drainage but considered extinct by the U.S. Fish and Wildlife Service (USFWS). No mussels were collected at four of the 30 stations.

INTRODUCTION

The mussel and fish faunas of the Mobile River Basin are noteworthy for their high degrees of endemism, and the basin is second only to the Tennessee River in terms of freshwater mussel diversity (Williams, 1982). This diversity is attributed to the physiographic heterogeneity of the basin and associated aquatic habitats, geographic barriers such as the Fall Line, and close proximity to adjacent drainages with diverse faunas (Williams et al., 1992). Hinkley (1906) reported 40 mussel species from the Tombigbee River system alone, whereas Williams et al. (1992) report that 50 species are known from in the upper Tombigbee (upstream of the confluence of the Tombigbee and Black Warrior Rivers) and 48 in the Black Warrior. Impoundment, eutrophication, sedimentation, pollution, and channel modifications, and the resultant fragmenting of populations, have likely contributed to declines in the freshwater mussel fauna (Hartfield, 1994; Mott and Hartfield, 1994).

Freshwater Mussel Records

Currently, 17 species of mussels in the Mobile River Basin are recognized as endangered or threatened by the USFWS (1987; 1990; and 1993) and 14 Mobile basin endemics in the genus *Pleurobema* are considered extinct by the USFWS (Hartfield, 1994). The type locality for one of these extinct species, *P. hagleri* (Frierson, 1900), is the North River near Tynes, and was known to exist prior to 1920 (van der Schalie, 1981). (Note: there is no record of such a community, and the correct spelling is probably ATyner@, a community reported by Rich [1979] to have once existed in the North River vicinity, Tuscaloosa County, but whose post office was discontinued in 1901). Ortmann (1923) reported four specimens of *P. hagleri* from the H. H. Smith collection from the North River and Valley Creek, Jefferson County.

A water quality and biological study of the Lake Tuscaloosa watershed (Mettee et al., 1990) found that runoff from coal-mining operations affected the water quality and biological communities of the system. Increases in average annual specific conductance values of 230% (32-74 μS/cm) in Lake Tuscaloosa at the spillway and 1,165% (17-198 μS/cm) in Turkey Creek along with declines in fish abundance were observed at several stations over a 10- to 15-year period.

STUDY AREA

The Mobile River Basin is the largest Gulf Coast river basin east of the Mississippi River, draining 113,139 km^2 in Alabama, Mississippi, Georgia, and Tennessee, including 83,416 km^2, or 62%, of the land area of Alabama (Mettee et al., 1996). The Black Warrior River drains 16,130 km^2 in north central Alabama, including portions of the Cumberland Plateau and East Gulf Coastal Plain physiographic sections (Mettee et al., 1996). The North River is a major tributary of the Black Warrior River and drains an area of 1,100 km^2 in Fayette, Tuscaloosa, and Walker Counties. The eastern part of the drainage occurs in the Warrior Basin District of the Cumberland Plateau, and the western and southeastern portions drain the Fall Line Hills District of the East Gulf Coastal Plain (Bodiford, 1981). The North River joins the Black Warrior River at the Fall Line near Tuscaloosa.

The North River drainage is underlain by two geologic formations. Rock strata of the Pottsville Formation of Pennsylvanian age are exposed along the northeastern part of the watershed. More permeable Coker Formation of Cretaceous age crops out in western and southern parts of the watershed. Streamflow rates in the upper North River are influenced by these formations, with streams draining sand and gravel deposits of the Coker Formation having well-sustained base flows during even the driest years, and those draining the more impermeable Pottsville Formation experiencing quick changes in flow from wet to dry seasons and reduced flows during dry seasons, and may be reduced to isolated pools.

North River within the study area varied from 20-25 meters in width at the downstream sampling stations to 5-7 meters at the most upstream station (30). In the vicinity of a proposed water supply reservoir in Fayette County (just upstream of station 14) stream widths averaged 12-15 meters. Stream habitat ranged from long pools with slow current to short shoal areas containing riffles and runs with slow to moderate current. Substrate was typical of streams in the region, dominated by sand and gravel. Bedrock areas where

underlying rock strata were exposed were interspersed with boulders, cobble, gravel, and sand. Some shoal areas contained rooted aquatic vegetation. Down timber and detritus provided microhabitats and nutrients, and often the stream passage was blocked from bank to bank by logjams. Most sampling was conducted during the fall when streams were at or near base flow. Evidence of beaver (*Castor canadensis* Kuhl) activity was observed at most stations, and in several reaches beaver dams extended across the main channel of North River. At these sites, pool habitat was increased and riffle habitat was reduced from inundation. At most stations stream banks were stable and vegetated. Bottomland hardwoods and pine plantations were present in much of the watershed and clear-cuts were observed sporadically throughout the watershed. Fields for row crops such as corn and soybeans were frequently encountered, though most were separated from the stream by strips of trees or brush. Evidence of recent and historical surface mining operations was observed near many stations within the watershed. Small deltas of silt or sand mixed with coal particles were observed at tributary/river confluences.

MATERIALS AND METHODS

Sampling was confined to the river reach upstream of Lake Tuscaloosa, a water supply reservoir in the lower portion of the drainage impounded in 1969. Stations were located with the aid of county highway maps or U.S. Geological Survey 1:250,000 topographic maps and were reached via canoe, bridge crossing, or foot trail.

Collections were made by hand, often with a mask and snorkel or viewing bucket. Some specimens also were collected from animal middens. All collections were strictly qualitative, and effort expended between stations varied. Factors influencing the collections included personnel involved, conditions at time of collection such as depth and clarity of water and weather, and time constraints. Collections at each station generally persisted until reasonable effort had been expended searching all available habitat for mussels. In addition to noting species present, we noted physical habitat and obvious or potential sources of impact within each stream reach and station. Voucher specimens were retained by the authors, or were deposited in the Florida Museum of Natural History, the Mississippi Museum of Natural Science, or the Ohio State University Museum of Biological Diversity. Nomenclature follows Turgeon et al. (1998).

RESULTS AND DISCUSSION

Collections at 30 stations in the North River system [Figure 1] yielded 14 species of native freshwater mussels (224 total live and dead specimens) and the exotic Asian clam, *Corbicula fluminea* (Müller 1774) [Table 1, Appendix 1]. Live specimens of eight species, fresh dead specimens of five species, and one species represented by a single weathered dead shell were collected. Two species subsequently protected under the Endangered Species Act, the dark pigtoe, *Pleurobema furvum* (Conrad 1834) and the orange-nacre mucket, *Lampsilis perovalis* (Conrad 1834), were collected alive. We did not collect the triangular kidneyshell, *Ptychobranchus greenii* (Conrad 1834), a species also subsequently protected by the Act that

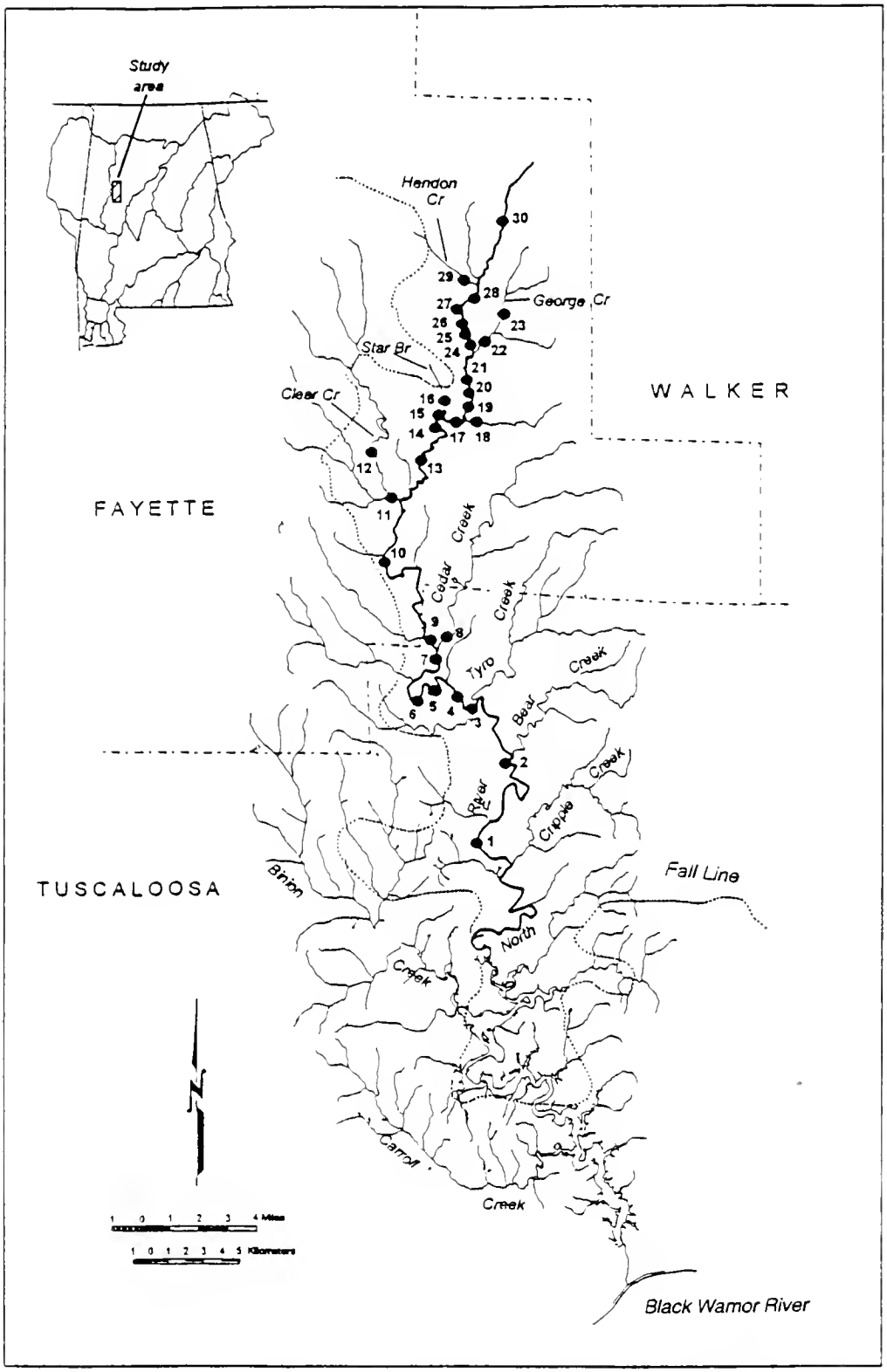

Figure 1. Map of the study area showing collection stations, relevant county boundaries, and position of the Fall Line.

Table 1-Summary of mussel collections in the North River system, Alabama, 1991-96. Numbers in parentheses after common names are numbers collected and percent relative abundance, respectively. A=Alive, FD=Fresh dead, WD=Weathered dead

Taxon/Common name	Station	Condition		
Amblema plicata (Say, 1817) threeridge (1,0.45)	1		FD	
Elliptio arca (Conrad, 1834) Alabama spike (3,1.3)	6, 8		FD	
E. arctata (Conrad, 1834) delicate spike (3,1.3)	1, 5, 6		FD	WD
Lampsilis ornata (Conrad, 1835) southern pocketbook (15,6.7)	1, 7, 8, 11, 15		FD	WD
L. perovalis (Conrad, 1834) orange-nacre mucket (10,4.5)	1, 4, 7, 9, 10	A	FD	WD
L. s. claibornensis (I. Lea, 1838) southern fatmucket (27,12.1)	2, 6, 7, 8, 9, 10, 11, 12, 13, 20, 21, 22, 28	A	FD	WD
L. teres (Rafinesque, 1820) yellow sandshell (1,0.45)	8			WD
Pleurobema furvum (Conrad, 1834) dark pigtoe (26,11.6)	6, 7, 11	A	FD	WD
Pyganodon grandis Say, 1829 giant floater (1,0.45)	19		FD	
Quadrula asperata (I. Lea, 1861) Alabama orb (37,16.5)	1, 2, 3, 4, 5, 6, 7, 10, 13	A	FD	WD
Strophitus subvexus (Conrad, 1834) southern creekmussel (50,22.3)	1, 2, 3, 6, 7, 8, 10, 11, 12, 13, 14, 15, 17, 19, 20, 21, 22, 23, 25, 26, 27, 28	A	FD	WD
Tritogonia verrucosa (Rafinesque, 1820) pistolgrip (12,5.4)	1, 2, 3, 4, 6, 7, 10	A	FD	WD
Villosa lienosa (Conrad, 1834) little spectaclecase (17,7.6)	7, 8, 9, 11, 12, 17, 20, 22	A	FD	WD
V. vibex (Conrad, 1834) southern rainbow (21,9.4)	5, 8, 11, 12, 13, 15, 20, 21, 22, 24, 25, 26, 27, 28	A	FD	WD
Corbicula fluminea (Müller, 1774) Asian clam	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19, 20, 21	A	FD	WD

was reported by van der Schalie (1981) to occur in the drainage before 1920, nor the brown pigtoe, *Pleurobema hagleri* (Frierson 1900), another species known from the drainage before 1920. *Corbicula* was commonly encountered throughout the study area with the exception of a few headwater and tributary stations (Table 1). No mussels were collected at the most upstream main channel station (30) and at three small headwater tributary stations (16,18,29).

The most widely distributed species were the southern creekmussel, *Strophitus subvexus* (Conrad 1834), collected at 23 of 30 stations, the southern rainbow, *Villosa vibex*, collected at 14 stations, and *Lampsilis straminea claibornensis* (I. Lea 1838), collected at 13 stations. Numerically dominant mussels collected in the study area include *S. subvexus* (N=50), *Quadrula asperata* (I. Lea 1861) (N=37), *L. s. claibornensis* (N=27), *Pleurobema furvum* (N=26), and *Villosa vibex* (N=21). Station 7 yielded the most diverse and abundant fauna, with 39 specimens from eight species and *Corbicula* present. A nearby tributary, Cedar Creek (station 8), yielded seven species, as did the main channel station (9) immediately upstream. The following are brief accounts of species collected.

Amblema plicata (Say 1817) A single fresh dead shell of the commercially valuable three ridge was collected at the most downstream station sampled (station 1). It is common and widespread, tolerant of a wide variety of habitats, and seems capable of thriving in polluted water (Oesch, 1995).

Elliptio arca (Conrad 1834) Fresh dead and weathered dead shells of the Alabama spike were collected in the North River main channel (station 6) and in a small tributary (station 8). Stansbery (1976) considered this species (as *E. arcus*) endangered.

Elliptio arctata (Conrad 1834) The delicate spike was reported by H. H. Smith (in van der Schalie, 1981) at Hagler=s Mill in 1911. Fresh dead and weathered dead shells were collected at North River stations 1, 5, and 6.

Lampsilis ornata (Conrad 1835) The southern pocketbook is a tolerant species common in the Mobile Basin. Fresh dead and weathered dead shells were collected at three main channel stations (1, 7, 15) and two tributary stations (8, 11).

Lampsilis perovalis Stansbery (1976) considered the orange-nacre mucket endangered, and in 1993 it was subsequently listed under the Endangered Species Act as a threatened species. During this survey it was found alive at two main channel stations (1, 7) and as fresh or weathered dead material at three main channel stations (4, 9, 10).

Lampsilis straminea claibornensis The southern fatmucket was widespread and common (both alive and as fresh or weathered dead material) throughout the drainage and was collected at both main channel (2, 6, 7, 9, 10, 13, 20, 21, 28) and tributary (8, 11, 12, 22) stations.

Lampsilis teres (Rafinesque 1820) A weathered dead shell of the normally widespread and common yellow sandshell was collected in a single tributary (station 8).

Pleurobema furvum The dark pigtoe was collected alive at two main channel stations (6, 7) and fresh dead at one main channel station (11). One collection at station 7 yielded 15 fresh dead specimens recovered from an animal midden near a shallow gravel riffle along with shells of six other mussel species.

Pyganodon grandis (Say 1829) One fresh dead specimen of the giant floater was

collected in the upper main channel (station 19) in an area impacted by beavers (i.e., large deposits of unconsolidated sand and silt with reduced flow), providing its preferred habitat of mud or a mud-gravel mix in quiet water (Oesch 1995). *Pyganodon grandis* was known as *Anodonta grandis* until the phylogenetic relationship among North American *Anodonta* was revised by Hoeh (1990).

Quadrula asperata (I. Lea 1861) The Alabama orb is a common, widespread, and morphologically variable species tolerant of a wide variety of habitat conditions. It was collected at nine main channel stations (1, 2, 3, 4, 5, 6, 7, 10, 13).

Strophitus subvexus (Conrad 1834) The southern creekmussel is widespread and common in the Mobile basin. During this survey it was collected at 17 main channel stations (1, 2, 3, 6 ,7, 10, 13, 14, 15, 17, 19, 20, 21, 25, 26, 27, 28) and at stations in three tributaries (8, 11, 12, 22, 23). It was the most frequently encountered and most abundant species collected.

Tritogonia verrucosa (Rafinesque 1820) The pistolgrip was collected at seven main channel stations (1, 2, 3, 4, 6, 7, 10), including a single live specimen at station 7. It is commonly found in larger creeks and rivers.

Villosa lienosa (Conrad 1834) The little spectaclecase is a common and widespread species in small to medium streams, which was collected at four upper main channel stations (7, 9, 17, 20) and at stations in three tributaries (8, 11, 12, 22). Only one live individual was found (station 7).

Villosa vibex (Conrad 1834) The southern rainbow is a common and widespread species in headwater streams and was found throughout the study area in both upper main channel (5, 13, 15, 20, 21, 24, 25, 26, 27, 28) and tributary (8, 11, 12, 22) stations.

Unionid mussels are uncommon to rare in the upper North River system at the present time. The lack of historical or recent mussel surveys in the North River system makes it difficult to speculate on the present biological condition of the mussel fauna or to predict future trends in species abundance or composition. However, based on the apparent loss of such species as *Pleurobema hagleri* and *Ptychobranchus greenii* and the precipitous decline of mussel diversity and abundance in other parts of the Black Warrior system, it is presumed that the North River mussel fauna also has been severely depleted.

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LITERATURE CITED

Bodiford, B. G. 1981. Drainage areas for the lower Black Warrior River basin, Alabama. U.S. Geological Survey. Tuscaloosa, Alabama. 72 p.

Hartfield, P. 1994. Status review of select mussel species in the Mobile River basin. U.S. Fish and Wildlife Service. Jackson, Mississippi. 3 p.

Hoeh, W. R. 1990. Phylogenetic relationships among Eastern North American *Anodonta* (Bivalvia: Unionidae). *Malacological Review*. 23(1-2): 63-82.

Hinkley, A. A. 1906. Some shells from Mississippi and Alabama. *Nautilus*. 20(3, 4, & 5): 34-36, 40-44, 52-55.

Mettee, M. F., O=Neil, P. E., and Pierson, J. M. 1996. Fishes of Alabama and the Mobile basin including Mobile basin tributaries in adjacent states. Oxmoor House. Birmingham, Alabama. 820 p.

-----, M. F., Harris, S. C., Shepard, T. E., McGregor, S. W., and O'Neil, P. E. 1990. Biological monitoring in four tributaries to Lake Tuscaloosa, Tuscaloosa County, Alabama. *Geological Survey of Alabama Circular* 148. 43 p.

Mott, S., and Hartfield, P. 1994. Status review summary of the Alabama pearlshell, *Margaritifera marrianae*. U.S. Fish and Wildlife Service. Jackson, Mississippi. 6 p.

Oesch, R. D., 1995. Missouri naiades: A guide to the mussels of Missouri. Missouri Department of Conservation. Springfield, Missouri. 271 p.

Ortmann, A. E. 1923. The anatomy and taxonomy of certain unioninae and anodontinae from the Gulf drainage. *Nautilus*. 36(3): 72-133.

Rich, J. S. 1979. The place-names of Greene and Tuscaloosa counties, Alabama. PhD Dissertation, University of Alabama, Tuscaloosa. 653 p.

Stansbery, D. H., 1976. Naiad mollusks: in *Bulletin Alabama Museum of Natural History* (edited by H. T. Boschung). 2: 42-52.

Turgeon, D. D., Quinn, Jr., J. F., Bogan, A. E., Coan, E. V., Hochberg, F. G., Lyons, W. G., Mikkelsen, P. M., Neves, R. J., Roper, C. F. E., Rosenberg, G., Roth, B., Scheltema, A., Thompson, F. G., Vecchione, M., and Williams, J. D., 1998. Common and scientific names of aquatic invertebrates from the United States and Canada: mollusks, second edition. American Fisheries Society, Special Publication 26. Bethesda, Maryland. 526 p.

USFWS, 1987, Endangered and threatened status for Marshall's mussel (*Pleurobema marshalli*), Curtus' mussel (*Pleurobema curtum*), Judge Tait's mussel (*Pleurobema taitianum*), the stirrup shell (*Quadrula stapes*), and the penitent mussel (*Epioblasma (=Dysnomia) penita*): Notification of publication of final rule, Federal Register, v. 52, no. 66, p. 11162-11169.

-----1990, Determination of threatened status for the inflated heelsplitter, (*Potamilus inflatus*): Notification of publication of final rule, Federal Register, v. 55, no. 189, p. 39868-39872.

-----1993, Endangered and threatened wildlife and plants; endangered status for eight freshwater mussels and threatened status for three freshwater mussels in the Mobile [sic] River drainage: Federal Register, v. 58, no. 50, p. 14330-14340.

van der Schalie, H., 1981. Mollusks in the Alabama River drainage, past and present. *Sterkiana*. 71: 24-40.

Williams, J. D., 1982. Distribution and habitat observations of selected Mobile Basin Unionid mollusks: in *Report of the Freshwater Mollusks Workshop, Final Report*, A. C. Miller, compiler. P. 61-85.

Williams, J. D., Fuller, S. L., and Grace, R. 1992. Effects of impoundments on freshwater mussels (Mollusca: Bivalvia: Unionidae) in the main channel of the Black Warrior and Tombigbee rivers in western Alabama. *Bulletin of the Alabama Museum of Natural History*. 13: 1-10.

Appendix 1-Summary of stations sampled for freshwater mussels in the North River, Fayette and Tuscaloosa Counties, Alabama, 1991-96.

Station no.	Locality	Coordinates
1-	North River at Samantha, Tuscaloosa County Hwy. 38	T. 18 S., R. 10 W., sec. 16/17
2-	North River near mouth of Bear Creek, Tuscaloosa County	T. 17 S., R. 10 W., sec. 34
3-	North River 0.1 mile upstream of Wittson Bridge, Tusc. Co.	T. 17 S., R. 10 W., sec. 29
4-	North River 0.4 mile upstream of Wittson Bridge, Tusc. Co.	T. 17 S., R. 10 W., sec. 20
5-	North River 0.3 mile downstream of Tuscaloosa Co. Hwy. 63	T. 17 S., R. 10 W., sec. 19
6-	North River upstream of Tuscaloosa County Hwy. 63	T. 17 S., R. 10 W., sec. 19
7-	North River below confluence of Cedar Cr. Tuscaloosa Co.	T. 17 S., R. 10 W., sec. 18
8-	Cedar Creek near confluence with North River, Tuscaloosa Co.	T. 17 S., R. 10 W., sec. 18
9-	North River upstream of confluence Cedar Cr. Tuscaloosa Co.	T. 17 S., R. 10 W., sec. 18
10-	North River at Alabama Hwy. 18, Fayette County	T. 16 S., R. 11 W., sec. 26
11-	Clear Creek downstream of Alabama Hwy. 13, Fayette County	T. 16 S., R. 11 W., sec. 14
12-	Clear Creek upstream of Fayette County Hwy. 93	T. 16 S., R. 11 W., sec. 11
13-	North River at Fayette County Hwy. 30	T. 16 S., R. 10 W., sec. 7
14-	North River at proposed dam site, Fayette County	T. 15 S., R. 10 W., sec. 31
15-	North River upstream of proposed dam site, Fayette County	T. 15 S., R. 10 W., sec. 31
16-	Star Branch near confluence with North River, Fayette County	T. 15 S., R. 10 W., sec. 31
17-	North River downstream of Cane Creek, Fayette County	T. 15 S., R. 10 W., sec. 32
18-	Cane Creek near confluence with North River, Fayette County	T. 15 S., R. 10 W., sec. 32
19-	North River near Laney Branch, Fayette County	T. 15 S., R. 10 W., sec. 29
20-	North River downstream of unnumbered Fayette County Hwy.	T. 15 S., R. 10 W., sec. 29
21-	North River upstream of unnumbered Fayette County Hwy.	T. 15 S., R. 10 W., sec. 29
22-	George Creek near confluence with North River, Fayette Co.	T. 15 S., R. 10 W., sec. 20
23-	George Creek upstream of Fayette County Hwy. 63	T. 15 S., R. 10 W., sec. 16
24-	North River west of Fayette County Hwy. 63	T. 15 S., R. 10 W., sec. 17
25-	North River west of Fayette County Hwy. 63 (upstream of 24)	T. 15 S., R. 10 W., sec. 17
26-	North River west of Fayette County Hwy. 63 (upstream of 25)	T. 15 S., R. 10 W., sec. 17
27-	North River downstream of Lowery Branch, Fayette County	T. 15 S., R. 10 W., sec. 8
28-	North River at Fayette County Highway 63	T. 15 S., R. 10 W., sec. 5/8
29-	Hendon Creek east of Fayette County Highway 63	T. 15 S., R. 10 W., sec. 5
30-	North River at Alabama Highway 102, Fayette County	T. 14 S., R. 10 W., sec. 28

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THE VASCULAR FLORA OF LAKE GUNTERSVILLE STATE PARK PART I . INTRODUCTION AND PLANT COMMUNITIES

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ABSTRACT

The general history, physiography, and geology are discussed for Lake Guntersville State Park, located in Marshall County, Alabama. Twelve plant communities are qualitatively described within the park. They include sandstone outcrops, sandstone bluffs, oak-hickory-pine forests, calcareous woods, limestone bluffs, mesophytic forests, low woods, stream banks, marshes, swamps, aquatic vegetation, and ruderal communities.

INTRODUCTION

The Study Area

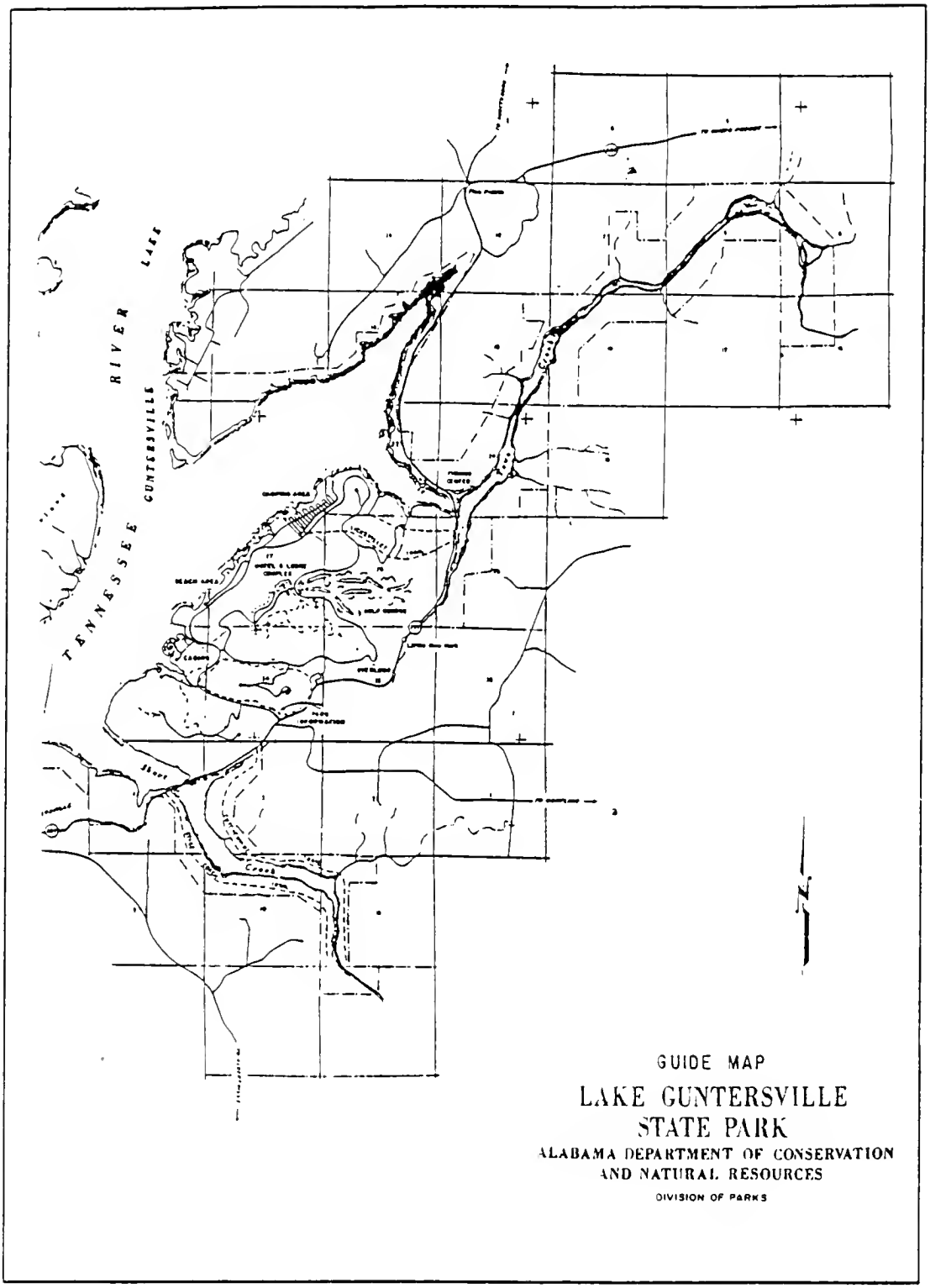
Lake Guntersville State Park (Figure 1) encompasses about 2,528 hectares (6,243 acres) of land. It is located in Marshall County, Alabama, which is in the northeastern part of the state. The park is about 10 kilometers (6 miles) northeast of Guntersville off State Road 227. The major part of the park includes Taylor Mountain, Graveyard Hill, Ellenburg Mountain and portions of Sand Mountain, Stubblefield Mountain, John Doss Mountain, and Little Mountain.

The Tennessee River (part of Lake Guntersville) forms its western border and is the major drainage system for the county and the State Park. The river enters the county in the northeast, flowing southwest. Near Guntersville it turns northwest flowing through the valleys it helped to carve. Other lotic systems that drain the park include Town Creek, Short Creek, Minky Creek and Hurricane Creek.

General History

The State Park was first established under the name Little Mountain State Park in 1947 when the Tennessee Valley Authority (T.V.A.) deeded to the State of Alabama 1619 hectares (4000 acres) of land. In 1969, it was renamed Lake Guntersville State Park after an acquisition of 648 hectares (1600 acres) of land. The most recent acquisition occurred in 1994 with the assistance of the Alabama Natural Heritage Program and The Nature Conservancy. This new property has an area of 98 hectares (243 acres) and is titled the Monsanto Tract. It is located on Dividing Ridge, northeast of Buck Island and southwest

FIGURE 1. Map of Lake Guntersville State Park



of Meltonsville.

The lake is a man-made reservoir created in January 1939 by completion of Guntersville Dam (Duncan and Smith 1969). The Lock and Dam are about 16 kilometers (10 miles) west of the park along the Tennessee River. Lake Guntersville includes portions of Spring Creek, Browns Creek, Honeycomb Creek, Minky Creek, Town Creek, Short Creek and the Tennessee River. The park contains 81 kilometers (50 miles) of shoreline along this reservoir.

Physiography and Topography

Marshall County lies within the Cumberland Plateau Section of the Appalachian Plateaus Province. The altitude of the Plateau ranges from 329 m to 419 m (1080 ft to 1374 ft) above sea level (Fenneman 1938). The highest point in the park occurs on Taylor Mountain and is 363 m (1190 ft) above sea level; it is occupied by the Lake Guntersville State Park Lodge. Lake shores are about 181 m (595 ft) above sea level.

Johnston (1930) defines five districts of the Cumberland Plateau occurring within the boundaries of Marshall County which include the Sequatchie Valley, Sand Mountain, Jackson County Mountains, Warrior Basin and Moulton Valley districts. Most of Lake Guntersville State Park is in the Sequatchie Valley district. Only small portions of Sand Mountain District occur on the plateau above Town Creek and Short Creek. The Jackson County Mountains, Warrior Basin, and Moulton Valley districts are located outside of the park.

Geology

The Cumberland Plateau is geologically very old (from 280 to 430 million years old) and its Paleozoic rocks are sedimentary in origin (Adams *et al.* 1926). The Cumberland Plateau is capped by resistant rocks of the Pottsville Formation, which date back to the Pennsylvanian period and consists mostly of sandstone and shale (Hack 1966). In the Sand Mountain District of the park, the Pottsville Formation is exposed along Town Creek and Short Creek; in the Sequatchie Valley District, the formation occurs on the crests of Graveyard Hill, Ellenburg Mountain and Taylor Mountain. Sanford (1966) maps out nine beds, which underlie the Pottsville formation in the vicinity of Lake Guntersville State Park. Most of the exposed rocks under the summit formation in the park is Bangor Limestone.

DESCRIPTION OF PLANT COMMUNITIES

A number of plant communities are found within the park. They include sandstone outcrops, sandstone bluffs, oak/hickory/pine forests, calcareous woods, limestone bluffs, mesophytic forests, low woods, stream banks and margins, marshes and swamps, aquatic vegetation, and ruderal communities.

Sandstone Outcrops

Sandstone glades are located along the canyon shoulders of Town Creek and Short Creek on Sand Mountain. These rock outcrops are produced and maintained by sheet and gully erosion along the edges of the plateau (Whetstone 1981). Soils are often shallow to nonexistent because of this process; accumulation does occur in depressions, cracks and crevices. The appearance of the topography tends to be flat, however, it is actually sloping toward the valleys. The adjacent upslope community is an upland oak/hickory/pine woodland and the transitional ecotone tends to be very scrubby. Seepage from deeper soils above, especially in the spring, creates wet areas in the form of pools and runs.

Very few trees and shrubs are able to grow in the thin soils of outcrops, so the habitat is very open and provides little shade. Scrub pines (*Pinus virginiana*) are the only trees that would be considered common, yet they are scattered and their stunted growth gives them the characteristic "bonsai" appearance. Shrubs that are often encountered are dwarf hawthorn (*Crataegus uniflora*) and sparkleberry (*Vaccinium arboreum*). Sparkleberry is sometimes called the tree blueberry because of its normally large size. However, in this environment its growth is very retarded and it hardly resembles the giants that grow in the deeper soils of the woods. On the bare rock surfaces, crustose and foliose lichens form vibrant blotches. Fruticose lichens called reindeer-moss (*Cladonia* spp.), true mosses (*Grimmia* and *Polytrichum*), and rush-foil (*Crotonopsis elliptica*), are frequent where a little soil accumulates. This exposed and well-drained community also produces ecological niches for succulents such as false-aloe (*Manfreda virginica*), eastern prickly-pear (*Opuntia humifusa*), and fameflower (*Talinum mengesii*).

The herbaceous plant community tends to be very diverse due to the various microhabitats that are produced. In depressions on rock surfaces, which become vernal pools in early spring, elf-orpine (*Diamorpha smallii*) with its dark red succulent leaves and Appalachian sandwort (*Minuartia glabra*) with its dainty white flowers form colorful islands. Later in the season, Little River Canyon onion *(Allium speculae*) and Texas sunnybells (*Schoenolirion wrightii*) dominate the thin soils of the outcrop. Soon, other wildflowers burst on the scene with an array of colors such as Curtiss' milkwort (*Polygala curtissii*), small-headed blazing-star (*Liatris microcephala*), blue-curls (*Trichostema dichotomum*), long-leaf sunflower (*Helianthus longifolius*), large-flowered tickseed (*Coreopsis grandiflora*), Sampson's snakeroot (*Orbexilum pedunculatum*), rayless goldenrod (*Bigelowia nuttallii*), black-senna (*Seymeria cassioides*), yellow jessamine (*Gelsemium sempervirens*), orange-grass (*Hypericum gentianoides*), and piedmont false-pimpernel (*Lindernia monticola*). Some of the rarer plants that are characteristic of these outcrops include the orchid called lesser ladies'-tresses (*Spiranthes ovalis*), indian paint-brush (*Castilleja coccinea*), and the parasitic Harper's dodder (*Cuscuta harperi*) which is often growing on *Bigelowia*, one of its favorite hosts. Graminoids that are commonly found include downy oatgrass (*Danthonia sericea*), crinkled hairgrass (*Deschampsia flexuosa*), churchmouse three-awn (*Aristida dichotoma*), secund rush (*Juncus secundus*) and globe beakrush (*Rhynchospora globularis*).

Sandstone Bluffs

Sandstone cliffs are vertical rock faces adjacent to the canyon shoulders. Few vascular plants are able to grow in this community. Vegetation adapted to the conditions has to be able to anchor their roots in the cracks and fissures in the wall. Woody plants such as scrub pine (*Pinus virginiana*), fringe tree (*Chionanthus virginicus*), mountain-laurel (*Kalmia latifolia*), catawba rhododendron (*Rhododendron catawbiense*), downy serviceberry (*Amelanchier arborea*), sweet birch (*Betula lenta*) and bush-honeysuckle (*Diervilla rivularis*) occur on the rim and ledges of the bluff. Some herbaceous plants such as Pennsylvania sedge (*Carex pensylvanica*), wreath goldenrod (*Solidago caesia*) and wood aster (*Aster divaricatus*) are able to occupy the smaller crevices in the nearly perpendicular cliffs of sandstone. Marginal shieldfern (*Dryopteris marginalis*) and mountain spleenwort (*Asplenium montanum*) also grow on these bluffs in places where there is some shade and moisture. Talus slopes are usually formed below the bluffs and support a different type of plant community.

Oak/Hickory/Pine Forests

Oak/hickory/pine woods are located throughout the park on ridge-tops and upper slopes facing east, west or south. This community also occurs on the lower portion of very steep slopes and on the surface of the plateau, which Whetstone (1981) calls the "tablelands." Soils are usually well-drained, thin, sandy and typically acidic. Slopes are often rocky with sandstone boulders and rubble. The community is often different down slope because the rock type changes to limestone. However, on steeper slopes, sandstone talus sometimes covers the lower slope and the oak/hickory/pine community extends to the bottom of the slope.

Common canopy trees occurring in various combinations include chestnut oak (*Quercus montana*), black oak (*Quercus velutina*), scarlet oak (*Quercus coccinea*), post oak (*Quercus stellata*), southern red oak (*Quercus falcata*), mockernut hickory (*Carya tomentosa*), sand hickory (*Carya pallida*), pignut hickory (*Carya glabra*), shortleaf pine (*Pinus echinata*), loblolly pine (*Pinus taeda*), and scrub pine (*Pinus virginiana*). On drier, rockier apex of slopes, chestnut oak and scrub pine are dominant species. This dominance gradually shifts down slope with a mixed community of hickories, oaks and pines. Associated canopy and subcanopy trees are black gum (*Nyssa sylvatica*), red maple (*Acer rubrum*), sourwood (*Oxydendrum arboreum*), persimmon (*Diospyros virginiana*), black cherry (*Prunus serotina*), sassafras (*Sassafras albidum*), and flowering dogwood (*Cornus florida*).

Shrubs and vines that are often encountered include oak-leaf hydrangea (*Hydrangea quercifolia*), beauty-berry (*Callicarpa americana*), St. Andrew's-cross (*Hypericum hypericoides*), maple-leaf viburnum (*Viburnum acerifolium*), lowbush blueberry (*Vaccinium pallidum*), muscadine grape (*Vitis rotundifolia*), and greenbrier (*Smilax* spp.). Groundcover often consists of greater tickseed (*Coreopsis major*), spotted wintergreen (*Chimaphila maculata*), flowering spurge (*Euphorbia corollata*), woods bedstraw (*Galium circaezans*), eastern blue-eyed-grass (*Sisyrinchium atlanticum*), milk-pea (*Galactia volubilis*), fire pink (*Silene virginica*), yellow crownbeard (*Verbesina occidentalis*), woolly elephant's-foot (*Elephantopus tomentosus*), wild yam (*Dioscorea villosa*), needle grass (*Stipa avenacea*), variable panic grass (*Dichanthelium commutatum*), spikegrass (*Uniola sessiliflorum*),

hedgehog woodrush (*Luzula echinata*), nut-rush (*Scleria oligantha*), Christmas fern (*Polystichum acrosticoides*), and ebony spleenwort (*Asplenium platyneuron*).

Calcareous Woods

This basic forest community usually occurs on lower slopes throughout the park, with the exception of steeper slopes off Sand Mountain along Town Creek and Short Creek. Soils are often thin, rocky and well-drained like sandstone slopes, but have a higher pH because of the limestone. North facing slopes normally have rich, mesic soils and support a greater assemblage of plants.

Chinquapin oak (*Quercus muehlenbergii*), white oak (*Quercus alba*), white ash (*Fraxinus americana*), shagbark hickory (*Carya ovata*) are the most common canopy trees of the calcareous woods. The following trees and shrubs are frequently found in the understory: red cedar (*Juniperus virginiana*), hop hornbeam (*Ostrya virginiana*), chalk maple (*Acer leucoderme*), red bud (*Cercis canadensis*), drooping gooseberry (*Ribes curvatum*), and Carolina buckthorn (*Rhamnus caroliniana*). In more mesic sites one can also find bladdernut (*Staphylea trifolia*), red buckeye (*Aesculus pavia*), glade-privet (*Forestiera ligustrina*) and buckthorn bumelia (*Bumelia lycioides*).

Showy herbaceous plants, known as wildflowers, are often abundant and diverse in this community, especially in the spring and on mesic slopes. They include the following species: heart-leaved skullcap (*Scutellaria ovata*), sweet Betsy (*Trillium cuneatum*), blue-star (*Amsonia tabernaemontana*), wild comfrey (*Cynoglossum virginianum*), green violet (*Hybanthus concolor*), Indian-pink (*Spigelia marilandica*), violet wood-sorrel (*Oxalis violacea*), blue cohosh (*Caulophyllum thalictroides*), tall bellflower (*Campanula americana*), shooting-star (*Dodecatheon meadia*), rue-anemone (*Thalictrum thalictroides*), slender toothwort (*Dentaria heterophylla*), few-flowered tick-trefoil (*Desmodium pauciflorum*), gromwell (*Lithospermum tuberosum*), southern wood violet (*Viola hirsutula*), frostweed (*Verbesina virginica*), pink boneset (*Eupatorium incarnatum*), wild hyacinth (*Camassia scilliodes*), and dwarf larkspur (*Delphinium tricorne*). Among the forbs, wood chess (*Bromus pubescens*), bottlebrush grass (*Elymus histrix*), poverty oatgrass (*Danthonia spicata*), woodland bluegrass (*Poa sylvestris*), wood grass (*Brachyelytrum erectum*), melic grass (*Melica mutica*), and the sedges *Carex artitecta* and *C. willdenowii* are frequently encountered.

Limestone Bluffs

Calcareous cliff communities are located mostly on lower slopes of the various mountains of the park, especially Taylor, Stubblefield, and John Doss mountains. Bedrock is usually Bangor Limestone and is exposed along Lake Guntersville, Town Creek, Short Creek and along some road cuts. Since limestone is less resistant to weathering, these slopes tend to have more ledges, cracks, and crevices than sandstone bluffs. Some other features which help to create more habitat diversity are solution pits and other solution features such as small sink holes and caves (Hill 1992). Because north-facing and shaded cliffs are generally more mesic, they often support a greater diversity of plants than exposed bluffs.

Plants of this community are adapted to well-drained soils with a higher pH and high

calcium content (Hill 1992). Trees often found in this habitat include chinquapin oak (*Quercus muehlenbergii*), white ash (*Fraxinus americana*), basswood (*Tilia americana*), red bud (*Cercis canadensis*), red cedar (*Juniperus virginiana*), and black walnut (*Juglans nigra*). Frequently encountered shrubs and woody vines are coral berry (*Symphoricarpus orbiculatus*), hairy mock-orange (*Philadephus hirsutus*), fragrant sumac (*Rhus aromatica*), rusty black haw (*Viburnum rufidulum*), poison-ivy (*Toxicodendron radicans*), and Virginia creeper (*Parthenocissus quinquefolia*). Some of the wildflowers that are characteristic of this community include small-flower leafcup (*Polymnia canadensis*), tall bellflower (*Campanula americana*), Short's aster (*Aster shortii*), round-leaved ragwort (*Senecio obovatus*), rock cress (*Arabis laevigata*), mullein fox-glove (*Dasistoma macrophylla*), wild stonecrop (*Sedum ternatum*), hairy alumroot (*Heuchera villosa*), thimbleweed (*Anemone virginiana*), cut-leaved toothwort (*Dentaria laciniata*), and early saxifrage (*Saxifraga virginiensis*). The sedge *Carex jamesii* is another calciphile that is found on the face of these bluffs. Among ferns, blackstem spleenwort (*Asplenium resiliens*) and purple cliff-brake (*Pellaea atropurpurea*) are common. One of the rarer ferns that was discovered in this type of habitat is bulblet bladder fern (*Cystopteris bulbifera*).

Mesophytic Forests

These rich woods occur on slopes and coves with a northern aspect. Slopes are often steep and the soils are well-drained, but because of the slope aspect, they are much more mesic than the oak/hickory/pine community. Improved moisture and often cooler temperature conditions alter the plant assemblage of north-facing slopes.

Canopy species include beech (*Fagus grandifolia*), tulip-poplar (*Liriodendron tulipifera*), basswood (*Tilia americana*), white oak (*Quercus alba*), white ash (*Fraxinus americana*), shagbark hickory (*Carya ovata*), sugar maple (*Acer saccharum*), and northern red oak (*Quercus rubra*). Also towering into the canopy layer is yellow buckeye (*Aesculus flava*). It is the largest buckeye and is somewhat rare in the park. Woody understory of the mesophytic forest includes trees and shrubs such as gray hydrangea (Hydrangea cinerea), sweet-shrub (*Calycanthus floridus*), witch-hazel (*Hamamelis virginiana*), leatherwood (*Dirca palustris*), mountain camellia (*Stewartia ovata*), sweet-leaf (*Symplocos tinctoria*), hop hornbeam (*Ostrya virginiana*), American holly (*Ilex opaca*), and cucumber magnolia (*Magnolia acuminata*).

Herbaceous ground cover in this community is noted for its diversity. The wildflowers are especially abundant in the spring before leaves are on the trees. The vernal flora often consists of large-flowered bellwort (*Uvularia grandiflora*), yellow mandarin (*Disporum lanuginosum*), doll's-eyes (*Actea pachypoda*), trout-lily (*Erythronium* spp.), spring-beauty (*Claytonia virginica*), wood anemone (*Anemone quinquefolia*), long-spurred violet (*Viola rostrata*), three-part-leaved violet (*Viola tripartita*), liverleaf (*Hepatica nobilis*), southern red trillium (*Trillium sulcatum*), water-leaf (*Hydrophyllum canadense*), foamflower (*Tiarella cordifolia*), may apple (*Podophyllum peltatum*), giant chickweed (*Stellaria pubera*), two-leaved toothwort (*Dentaria diphylla*), bloodroot (*Sanguinaria canadensis*), and blue phlox (*Phlox divaricata*). Yellow lady's-slipper (*Cypripedium calceolus*) was also encountered, but is very rare. Under the deep shade of the canopy in summer and fall the following

herbaceous plants grow: rattlesnake-plantain (*Goodyera pubescens*), false-hellebore (*Veratrum parviflorum*), arrow-leaf aster (*Aster sagittifolius*), heart-leaved aster (*Aster cordifolius*), wood aster (*Aster divaricatus*), goldenrod (*Solidago caesia* and *S. curtisii*), filmy angelica (*Angelica triquinata*), ginseng (*Panax quinquefolia*), horse-balm (*Collinsonia canadensis*), white snakeroot (*Eupatorium rugosum*), tick-trefoil (*Desmodium nudiflorum* and *D. glutinosum*), wood nettle (*Laportea canadensis*), maidenhair fern (*Adiantum pedatum*), Christmas fern (*Polystichum acrostichoides*), and broad beech fern (*Phegopteris hexagonoptera*).

Low Woods

Bottomland or lowland communities occur on alluvial floodplains of small streams and on old, low river terraces (alluvial flats) along Town Creek and Short Creek. Soils are fairly deep and are composed of mostly sand and silt. These areas are also periodically flooded, especially during winter and spring months. Sites that are more poorly drained could be classified as wetlands.

Canopy species of the low woods community often consist of tulip-poplar (*Liriodendron tulipifera*), sweet gum (*Liquidambar styraciflua*), red maple (*Acer rubrum*), bitternut hickory (*Carya cordiformis*), sugarberry (*Celtis laevigata*), water oak (*Quercus nigra*), and loblolly pine (*Pinus taeda*). Laurel oak (*Quercus laurifolia*) is frequent in coarser sands of old river terraces. Two other trees, river birch (*Betula nigra*) and sycamore (*Platanus occidentalis*) are also sometimes a component of this plant community. Woody taxa of the understory often include parsley-leaf hawthorn (*Crataegus marshallii*), strawberry-bush (*Euonymus americanus*), highbush blackberry (*Rubus argutus*), paw-paw (*Asimina* triloba), and rattan-vine (*Berchemia scandens*). Some aggressive alien species that have invaded this habitat are Chinese privet (*Ligustrum sinense*) and Japanese honeysuckle (*Lonicera japonica*).

Many herbaceous plants flourish in this community such as forget-me-not (*Myosotis macrosperma*), bluebells (*Mertensia virginica*), Virginian bugleweed (*Lycopus virginiana*), honewort (*Cryptotaenia canadensis*), clearweed (*Pilea pumila*), enchanter's-nightshade (*Circaea lutetiana*), dotted smartweed (*Polygonum punctatum*), calico aster (*Aster lateriflorus*), mist flower (*Eupatorium coelestinum*), and the exotic, long-bristled smartweed (*Polygonum caespitosum*). Among the forbs, autumn bluegrass (*Poa autumnalis*), white grass (*Leersia virginica*), and the sedges *Carex blanda*, *C. intumescens*, *C. granularis*, *C. cherokeensis*, and *C. oxylepis* are often present. Ferns such as New York fern (*Thelypteris noveboracensis*), lady fern (*Asplenium felix-femina*), and netted chain fern (*Woodwardia areolata*) also occur in this habitat. Adder's-tongue (*Ophioglossum vulgatum*), though rare, is also found in low woods.

Stream Banks and Margins

Bank habitats are relatively narrow, upland strips along larger streams and portions of Lake Guntersville. Plants growing here are adapted to frequent flooding and bank erosion. Woody vegetation tends to be more common than the herbaceous species due to the disturbance from flooding (Joyner and Chester 1994).

Typical overstory trees include sweet gum (*Liquidambar styraciflua*), silver maple (*Acer saccharinum*), Shumard oak (*Quercus shumardii*), water oak (*Quercus nigra*), river

birch (*Betula nigra*), loblolly pine (*Pinus taeda*), and sycamore (*Platanus occidentalis*). The very rare white walnut or butternut (*Juglans cinerea*) also occurs along the banks of Town Creek. Characteristic shrubs and small trees include tag alder (*Alnus serrulata*), ironwood (*Carpinus carolinianus*), silky dogwood (*Cornus amomum*), silverbell tree (*Halesia tetraptera*), elderberry (*Sambucus canadensis*), yellow-root (*Xanthorhiza simplisissima*), false-indigo (*Amorpha fruticosa*), Virginia-willow (*Itea virginica*), sweet azalea (*Rhododendron arborescens*), and piedmont azalea (*Rhododendron canescens*). Some rarer shrubs that grow along stream banks are withe-rod (*Viburnum cassinoides*), winterberry (*Ilex verticillata*), ninebark (*Physocarpus opulifolius*), and swamp sweetbells (*Leucothoe racemosa*).

Common grasses of this community are wild-oats (*Uniola latifolia*), wild-rye (*Elymus virginicus*), cane (*Arundinaria gigantea*) which often grows in thick stands, and the panic grasses, *Dichanthelium clandestinum* and *D. dichotomum*. Some of the wildflowers encountered are joe-pye-weed (*Eupatorium fistulosum*), smooth phlox (*Phlox glaberrima*), lance-leaf loosestrife (*Lysimachia lanceolata*), Carolina elephant's-foot (*Elephantopus caroliniana*), and ridged yellow flax (*Linum striatum*). The rarer wildflowers include such species as primrose-leaved violet (*Viola primulifolia*), narrow-leaved mountain-mint (*Pycnanthemum tenuifolium*), ground-nut (*Apios americana*), and beetleweed (*Galax urceolata*) which occurs on steeper stream banks of upper Town Creek.

A wetland plant community is often found along margins of streams, along shallow lakeshores, and on shoals. This community is associated with the bank habitat. Woody vegetation tends to be scarce because of the environmental pressures of almost constant flooding and soil removal (Tobe *et al.* 1992). With the abundance of light, herbaceous hydrophytes flourish. This habitat is similar to the marsh community, but differs because it is subjected to higher water velocity and/or wave action.

The hydrophytes found on shoals and along bank margins include the rushes *Juncus diffusissimus*, *J. validus*, and *J. acuminatus*. Other forbs such as manna grass (*Glyceria striata*), red-top panic grass (*Panicum rigidulum*), fringed sedge (*Carex crinita*), least spikerush (*Eleocharis acicularis*), and dusky bulrush (*Scirpus atrovirens*) are also common. Other wetland plants encountered include mad-dog skullcap, (*Scutellaria lateriflora*), dwarf St. John's-wort (*Hypericum mutilum*), false loosestrife (*Ludwigia decurrens*), winged monkey-flower (*Mimulus alatus*), yellow-seed false-pimpernel (*Lindernia dubia*), hedge-hyssop (*Gratiola neglecta*), marsh seedbox (*Ludwigia palustris*), cardinal flower (*Lobelia cardinalis*), arrow-leaf tearthumb (*Polygonum sagittatum*), and water-willow (*Justicia americana*). Two rare species found growing on a shoal in Town Creek are the state listed, weak-stem bulrush (*Scirpus purshianus*) and the exotic, water-pepper (*Polygonum hydropiper*).

Marshes and Swamps

Marshes and swamps are found adjacent to portions of Lake Guntersville and larger streams. Marshes sometimes grade into shrub swamps and then to forested swamps. A portion of the marsh at Minky Creek near Meltonsville is bordered by a pasture (part of the park's property) with some characteristics of a wet meadow. According to Mitsch and Gosselink (1993), a marsh is "a frequently or continually inundated wetland characterized by emergent herbaceous vegetation adapted to saturated soil conditions" and a wet meadow is

a "grassland with waterlogged soil near the surface but without standing water for most of the year."

Some of the emergent dicots that occur in the marshes are rose-mallow (*Hibiscus moscheutos*), seedbox (*Ludwigia decurrens*, *L. peploides*, and *L. palustris*), spearwort (*Ranunculus pusillus*), climbing hempweed (*Mikania scandens*), beggar-ticks (*Bidens frondosa* and *B. polylepis*), marsh bedstraw (*Galium tinctorium*), camphorweed (*Pluchea camphorata*), jewelweed (*Impatiens capensis*), arrow-leaf tearthumb (*Polygonum sagittatum*), and mild waterpepper (*Polygonum hydropiperoides*). Some of the rarer dicots are bladderwort (*Utricularia biflora*) and water-pod (*Hydrolea quadrivalvis*). Among the emergent monocots, which often dominate the marshes, water millet (*Zizaniopsis miliacea*), rice cutgrass (*Leersia oryzoides*), wool-grass (*Scirpus cyperinus*), cat-tail (*Typha latifolia*), sallow sedge (*Carex lurida*), hop sedge (*Carex lupulina*), soft rush (*Juncus effusus*), and leathery rush (*Juncus coriaceous*) are common. The bulrushes, *Scirpus americanus* and *S. validus*, are documented only from the marsh near Minky Creek and are considered rare in the park. Woody plants such as buttonbush (*Cephalanthus occidentalis*), elderberry (*Sambucus canadensis*), and tag alder (*Alnus serrulata*) are also scattered in some of the marshes. Two exotic herbaceous plants that have become established and are often very abundant are marsh dewflower (*Murdannia keisak*), and alligator-weed (*Alternanthera philoxeroides*).

Swamps, like marshes are wetlands with waterlogged soils, but are dominated by trees and shrubs. In the park, swamps are not as common as marshes and they are usually smaller in size. The dominant canopy trees are green ash (*Fraxinus pennsylvanica*), and black willow (*Salix nigra*); often scattered throughout the swamps are red maples (*Acer rubrum*). Some of the rarer trees encountered are water tupelo (*Nyssa aquatica*) and bald cypress (*Taxodium distichum*). The woody understory often includes swamp dogwood (*Cornus foemina*), Virginia-willow (*Itea virginica*), American snowbell (*Styrax americana*), buttonbush (*Cephalanthus occidentalis*), and tag alder (*Alnus serrulata*). Many of the herbaceous plants were the same ones growing in the marsh. Some of the taxa that are more prevalent in the swamps are marsh St. John's-wort (*Triadenum walteri*), ditch-stonecrop (*Penthorum sedoides*), Virginia dayflower (*Commelina virginica*), marsh pennywort (*Hydrocotyle verticillata*), lizard's-tail (*Saururus cernuus*), sensitive fern (*Onoclea sensibilis*), and netted chainfern (*Woodwardia virginica*).

Aquatic Vegetation

Submerged and floating aquatic plants occur in shallow to deep waters of Lake Guntersville and larger streams, where water flow tends to be sluggish. Cowardin *et al.* (1979) define deepwater habitats at about 2 meters (6.6 feet) which is the maximum depth emergents normally can grow. Even though aquatic vegetation is not restricted to shallow waters they tend to be more common along the shores.

Typical aquatic plants include water-nymphs (*Najas minor* and *N. guadalupensis*), pondweeds (*Potamogeton pusillus*, *P. nodosus* and *P. diversifolius*), coontail (*Ceratophyllum demersum*), and duckweeds (*Lemna valdiviana* and *Spirodela polyrhiza*). Some alien species are parrot-feather (*Myriophyllum aquaticum*) and Eurasian water-milfoil (*Myriophyllum spicatum*). The exotic *Hydrilla verticillata*, a pernicious weed, was collected washed up on

the shores of Lake Guntersville. Some rare and interesting submerged plants are curly pond weed (*Potamogeton crispus*) and broad waterweed (*Elodea canadensis*) which is state listed as critically imperiled (S1). Both were found in clear waters with a slight current.

Ruderal Communities

Ruderal communities occur in disturbed areas of the park. The flora often consists of weedy, non-native taxa. Habitats include roadsides, lawns, parking lots, campgrounds, sites along buildings, boat ramp areas, pastures, fields, ditches, and waste places. "Weeds" are able to compete and thrive in adverse conditions because of certain adaptations they possess. Many perennial species have the ability to regenerate lost parts or spread vegetatively if they are prevented from producing seeds. The strategy of annual plants is to survive in the form of seeds and they often produce an enormous amount of seeds each year (Muenscher 1955).

Some ruderal sites, like lawns, support a diversity of herbaceous weeds such as hairy bittercress (*Cardamine hirsuta*), henbit (*Lamium amplexicaule*), white clover (*Trifolium repens*), wild onion (*Allium canadense*), dandelion (*Taraxacum officinale*), corn speedwell (*Veronica arvensis*), field pansy (*Viola rafinesquii*), cudweed (*Gnaphalium purpureum*), dwarf-dandelion (*Krigia oppositifolia*), field madder (*Sherardia arvensis*), chickweed (*Stellaria media*), black medic (*Medicago lupulina*), bristle-mallow (*Modiola caroliniana*), mock-strawberry (*Duchesnea indica*), small bluets (*Houstonia pusilla*), and mouse-ear chickweed (*Cerastium glomeratum*).

In other sites, such as roadsides, fields and pastures, the following species are common: dog-fennel (*Eupatorium capillifolium*), plantain (*Plantago* spp.), horse-nettle (*Solanum carolinense*), hairy buttercup (*Ranunculus sardous*), fireweed (*Erechtites hieracifolia*), amaranth (*Amaranthus* spp.), bull thistle (*Cirsium vulgare*), horseweed (*Conyza canadensis*), jimsonweed (*Datura stramonium*), little barley (*Hordeum pusillum*), Johnson grass (*Sorghum halepense*), bristle grass (*Setaria* spp.), goose grass (*Eleusine indica*), path rush (*Juncus tenuis*), purple-top (*Tridens flavus*), Carolina crane's-bill (*Geranium carolinianum*), tall goldenrod (*Solidago canadensis*), partridge-pea (*Chamaecrista fasciculata*), Queen-Anne's-lace (*Daucus carota*), low hop clover (*Trifolium campestre*), fleabane (*Erigeron* spp.), bitterweed (*Helenium amarum*), woolly mullein (*Verbascum thapsus*), Brazilian vervain (*Verbena brasiliensis*), three-seeded-mercury (*Acalypha* spp.), ragweed (*Ambrosia artemisiifolia*), gray-green woodsorrel (*Oxalis dillenii*), thoroughwort (*Eupatorium* spp.), trumpet-creeper (*Campsis radicans*), silk tree (*Albizia julibrissin*), princess tree (*Paulownia tomentosa*), and smooth sumac (*Rhus glabra*).

Ditches and other wet, disturbed habitats support wetland plants such as Frank's sedge (*Carex frankii*), fescue sedge (*Carex festucacea*), rice flatsedge (*Cyperus iria*), straw-colored flatsedge (*Cyperus strigosus*), blunt spikerush (*Eleocharis obtusa*), barnyard grass (*Echinocloa crus-galli*), Pennsylvania smartweed (*Polygonum pensylvanicum*), lady's-thumb (*Polygonum persicaria*), blackening hedge-hyssop (*Mecardonia acuminata*), beefsteak plant (*Perilla frutescens*), curly dock (*Rumex crispus*), Indian-tobacco (*Lobelia inflata*), mock bishop's-weed (*Ptilimnium capillaceum*), water starwort (*Callitriche heterophylla*), seed-box (*Ludwigia* spp.),

butterweed (*Senecio vulgaris*), Virginian buttonweed (*Diodia virginiana*), and Asiatic dayflower (*Commelina communis*).

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LITERATURE CITED

Adams, G. I., C. Butts, L. W. Stephenson and W. Cooke. 1926. Geology of Alabama. Second printing 1979. Geological Survey of Alabama Special Report No. 14.

Cowardin, L.M., V. Carter, F.C. Golet, E.T. Laroe, 1979. Classification of Wetlands and Deepwater Habitats of the United States. U.S. Fish & Wildlife Service Pub. FWS/OBS-79/31, Washington, D.C.

Duncan, K. M., and L. J. Smith. 1969. The History of Marshall County, Alabama. Thompson Printing Co., Albertville.

Fenneman, N. M. 1938. Physiography of Eastern United States. McGraw Hill Book Company, Inc., New York.

Freeman, J. D., A. S. Causey, J. W. Short and R. R. Haynes. 1979. Endangered, threatened, and special concern plants of Alabama. Department of Botany and Microbiology, Agricultural Experiment Station, Departmental Series No. 3, Auburn University, Auburn.

Hack, J. T. 1966. Interpretation of Cumberland Escarpment and Highland Rim South-Central Tennessee and Northeast Alabama. U.S. Geol. Survey Prof. Paper 524-C: 1-16.

Hill, S. R. 1992. Calciphiles and calcareous habitats of South Carolina. Castanea 57: 25-33.

Johnston, W.. D. Jr. 1930. Physical divisions of northern Alabama. Alabama Geol. Survey Bull. 38.

Joyner J. M. and E. W. Chester. 1994. The vascular flora of Cross Creeks National Wildlife Refuge, Stewart County, Tennessee. Castanea 59: 117-145.

Mitsch, W. J. and J. G. Gosselink. 1993. Wetlands, 2nd edition. Van Nostrand Reinhold, New York.

Muenscher, W. C. 1955. Weeds, 2nd edition. Reissued 1980 with a new foreword and appendixes. Cornell University Press, Ithaca.

Sanford, T. H. Jr. 1966. Generalized geologic map of Marshall County, Alabama. Geological Survey of Alabama, Map 60.

Tobe J. D., J. E. Fairey III and L. L. Gaddy. 1992. Vascular flora of the Chauga River Gorge, Oconee County, South Carolina. Castanea 57: 77-109.

Whetstone, R. D. 1981. Vascular flora and vegetation of the Cumberland Plateau of Alabama including a computer-assisted spectral analysis and interpretive synthesis of the origin, migration, and evolution of the flora. Ph.D. dissertation, Department of Botany, The University of North Carolina at Chapel Hill.

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THE VASCULAR FLORA OF LAKE GUNTERSVILLE STATE PARK PART II . ANNOTATED CHECKLIST

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ABSTRACT

The vascular flora is documented for Lake Guntersville State Park, located in Marshall County, Alabama. A total of 1,072 specific and infraspecific taxa representing 521 genera and 143 families are documented in the 2,528 hectare study site, attesting to the great diversity of plant life of this area. Fifty-four species in the park have been listed by state or federal agencies as imperiled, rare, threatened, or endangered in Alabama; 189 species, growing without cultivation, are exotic, comprising 17.6 % of the flora.

METHODS

The main objective of this study was to document the vascular flora of Lake Guntersville State Park in Marshall County, Alabama. In order to obtain as complete a flora as possible, different plant communities and numerous sites were sampled. Collecting trips were made regularly during the growing season between August 1991 through October 1995 (and sporadically until September 1999). More than 3,000 collection numbers were compiled from the park. Standard field and herbarium techniques were utilized during this study. A complete set of voucher specimens has been labeled, mounted and deposited at the Herbarium of Jacksonville State University (JSU).

RESULTS AND DISCUSSION

Floristic Summary

The vascular flora of Lake Guntersville State Park includes 1,072 specific and infra-specific taxa representing a total of 521 genera, 143 families, 62 orders, 6 classes and 4 divisions. The ten largest families are Asteraceae with 149 taxa, Poaceae with 113 taxa, Cyperaceae with 69 taxa, Fabaceae with 63 taxa, Rosaceae with 37 taxa, Lamiaceae with 28 taxa, Liliaceae with 25 taxa, Ranunculaceae with 25 taxa, Scrophulariaceae with 22 taxa, and Apiaceae with 22 taxa. The largest genera include *Carex* (39 spp.), *Aster* (17 spp.), *Cyperus* (15 spp.), *Quercus* (13 spp.), *Juncus* (13 spp.), *Eupatorium* (12 spp.), *Polygonum* (12 spp.),

Crataegus (9 spp.), *Ranunculus* (9 spp.), *Coreopsis* (8 spp.), *Eragrostis* (8 spp.), *Hypericum* (8 spp.), *Paspalum* (7 spp.), and *Smilax* (7 spp.). Included in these statistics are 13 species that were not collected, but are reported to occur within the park. These plants are attributed to the park by the park's naturalist, Linda Reynolds, and her husband, Dick Reynolds. It can be concluded from this data that the biodiversity of plant life is exceedingly rich at Lake Guntersville State Park (and in the Sequatchie Valley). This region supports various types of habitats which contributes to the diversity of plant species.

A total of 189 exotic species, growing without cultivation, are documented, comprising 17.6% of the flora. Most of these alien plants are concentrated in ruderal areas and not in natural communities. Possible reasons for the greater number could be commercial boats on the Tennessee River and/or cars, campers and recreational vehicles of out-of-state visitors are transporting alien seeds. However, though some of the exotics may have been brought into the park by this avenue, the greater number of non-native plants collected is probably due to the author's zealous searches for plants in the disturbed areas. References used to determine nativities include Bailey and Bailey (1976), Fernald (1950), Muenscher (1955), and Wunderlin (1982).

Analysis of the flora determined that 54 species represented in the park are state or federally listed. Of the 54 species, 52 are treated in the Alabama Natural Heritage Program's *Vascular Plant Inventory Tracking List* (April 1994 edition) and *Species Inventory List* (1996); 11 are federally listed, five as C2 and six as 3C. The coded ranks are defined in Table 1and 2 (note that federal candidate status is no longer applicable). A total of 29 species were recorded in *Endangered, Threatened, and Special Concern Plants of Alabama* (Freeman *et al.* 1979); two of these plants, *Actea pachypoda* and *Diphasiastrum digitatum*, were found only on this list.

Table 1. Definition of State Ranks

State Ranks

Code

S1 **Critically imperilled** in Alabama because of extreme rarity or because of some factor(s) making it especially vulnerable to extirpation from Alabama.

S2 **Imperiled** in state because of rarity or because of some factor(s) making it very vulnerable to extirpation from Alabama.

S3 **Rare or uncommon** in Alabama.

S4 **Apparently secure** in Alabama, with many occurrences.

S5 **Demonstrably secure** in Alabama and essentially "ineradicable" under present conditions.

SH **Of historical occurrence**, perhaps not verified in the past 20 years, and suspected to be still extant.

SR **Reported**, but without persuasive documentation which would provide a basis for either accepting or rejecting the report.

SU **Possibly in peril** in Alabama, but status uncertain.

S? **Not ranked** to date.

Table 2. Definition of Federal Ranks

Federal Status

Code

LE **Endangered species**: in danger of extinction throughout all or a significant portion of their range.

LT **Threatened species**: likely to become an endangered species within the foreseeable future throughout all or a significant portion of their range.

PE **Proposed endangered**: species is proposed to be listed as endangered.

PT **Proposed threatened**: species is proposed to be listed a threatened.

C1 **Candidate species** for which the USFWS has on file enough substantial information on biological vulnerability and threat(s) to support proposals to list them as endangered or threatened.

C2 **Candidate species** for which information now in the possession of USFWS indicates that proposing to list as endangered or threatened is possibly appropriate, but for which conclusive data on biological research and field study usually will be necessary to ascertain the status of taxa in this category.

3A **Former candidate species** for which USFWS has persuasive evidence of *extinction*. If rediscovered, such species might acquire high priority for listing. At this time, however, the best available information indicates that the taxa in this subcategory, or the habitats from which they were known, have been lost.

3B **Unaccepted taxa** with names that, on the basis of current taxonomic understanding, do not represent distinct entities meeting the Act's definition of "species." Such proposed taxa could be reevaluated in the future on the basis of new information.

3C **Former candidate species** that have been proven to be *more abundant* or widespread than previously believed and/or those that are not subject to any identifiable threat. If further research or changes in habitat indicated a significant decline in any of these taxa, they may be reevaluated for possible inclusion in category 1 or 2.

ANNOTATED CHECKLIST

Species nomenclature and family circumscriptions are primarily those of Isley (19990) for the Fabaceae, Cronquist (1980) for the Asteraceae, Luer (1975) for the Orchidaceae, and Radford *et al.* (1968) for the rest of the angiosperms. Nomenclature follows Flora of North America [FNA] (1993+) for pteridophytes, gymnosperms and primitive dicots (Magnoliidae & Hamamelidae).

Synonymy is provided for recent nomenclatural changes and is italicized within brackets. Families, genera, specific and infraspecific taxa are arranged alphabetically within major vascular plant groups (Divisions and Classes). Introduced taxon are followed by a dagger (†). Federal or state listed species are followed by an asterisk(*) and their coded status designation (recent listing in plainface type; formerly listed status is preceded by an *x* and in *italics*). A collection number is provided for each taxon and noted if it was reported. The following section lists the vascular plants which occur in Lake Guntersville State Park and this represents the first essentially complete list for the area. A more complete (uncut) version of this work can be found in the Jacksonville State University Library in *The Vascular Flora of Lake Guntersville State Park, Marshall County* (Spaulding 1995).

DIVISION LYCOPODIOPHYTA

ISOETACEAE (Quillwort Family)

Isoetes engelmannii A. Br.* *xS3 DDS 3711*

LYCOPODIACEAE (Clubmoss Family)

Diphasiastrum digitatum (Dill. *ex* A. Br.) Holub
[*Lycopodium digitatum*; *L. flabelliforme*]
DDS 1176

SELAGINELLACEAE (Spikemoss Family)

Selaginella apoda (L.) Spring *DDS 9766*

DIVISION POLYPODIOPHYTA

ASPLENIACEAE (Spleenwort Family)

Asplenium bradleyi D.C. Eat.* S2 *DDS 2667*

A. montanum Willd. *DDS 1982*

A. platyneuron (L.) Oakes *DDS 873*

A. resiliens Kunze *DDS 1084*

A. rhizophyllum L. [*Camptosorus rhizophyllus*]
DDS 5077

BLECHNACEAE (Chain Fern Family)

Woodwardia areolata (L.) Moore
[*Lorinseria areolata*] *DDS 1489*

DENNSTAEDTIACEAE (Cuplet Fern Family)

Pteridium aquilinum (L.) Kuhn
var. *pseudocaudatum* (Clute) Heller *DDS 1424*

DRYOPTERIDACEAE (Wood Fern Family)

Athyrium filix-femina (L.) Roth
var. *asplenioides* (Michx.) Farw.
[*A. asplenioides*] *DDS 1439*

Cystopteris bulbifera (L.) Bernh.* xS? *DDS 1473*

C. protrusa (Weatherby) Blasdell
[*C. fragilis* var. *protrusa*] *DDS 1169*

Dryopteris marginalis (L.) Gray *DDS 1144*

Onoclea sensibilis L. *DDS 1445*

Polystichum acrostichoides (Michx.) Schott *DDS 908*

Woodsia obtusa (Spreng.) Torr. *DDS 1149*

OPHIOGLOSSACEAE (Adder's-tongue Family)

Botrychium biternatum (Savigny) Underw. *DDS 879*

B. dissectum Spreng. [*B. d.* var. *obliquum*]
DDS 6777a

B. virginianum (L.) Sw. *DDS 1276*

Ophioglossum vulgatum L. [*O. v.* var. *pycnostichum*]
DDS 3493

OSMUNDACEAE (Royal Fern Family)

Osmunda cinnamomea L. *DDS 1438*

O. regalis L. var. *spectabilis* (Willd.) Gray *DDS 1641*

POLYPODIACEAE (Polypody Family)

Pleopeltis polypodioides (L.) Andr. & Wind.
var. michauxiana (Weatherby) Andr. & Wind.
[*Polypodium polypodioides*] *DDS 4447*

PTERIDACEAE (Maidenhair Fern Family)

Adiantum pedatum L. *DDS 1296*

Pellaea atropurpurea (L.) Link *DDS 1086*

THELYPTERIDACEAE (Marsh Fern Family)

Phegopteris hexagonoptera (Michx.) Fee
[*Thelypteris hexagonoptera*] *DDS 1681*

Thelypteris noveboracensis (L.) Nieuwl. *DDS 1715*

DIVISION PINOPHYTA

CUPRESSACEAE (Cypress Family)

Juniperus virginiana L. *DDS 970*

Taxodium distichum (L.) L. Rich.., BALD-CYPRESS.
DDS 3075

PINACEAE (Pine Family)

Pinus echinata Mill. *DDS 1285*

P. palustris Mill. *DDS 2524*

P. taeda L. *DDS 941*

P. virginiana Mill. *DDS 943*

DIVISION MAGNOLIOPHYTA

CLASS MAGNOLIOPSIDA

ACANTHACEAE (Acanthus Family)

Justicia americana (L.) Vahl *DDS 1653*

Ruellia carolinensis (Walt.) Steud. *DDS 1856*

R. strepens L. *DDS 3136*

ACERACEAE (Maple Family)

Acer leucoderme Small
[*A. saccharum* spp. *leucoderme*] *DDS 931*

A. negundo L. *DDS 999*

A. rubrum L. *DDS 1079*

A. sacchorinum L. *DDS 3207*

A. saccharum Marsh. *DDS 1098*

AMARANTHACEAE (Amaranth Family)

Alternanthero philoxeroides (Mart.) Griseb.† *DDS 1600*

Amaranthus hybridus L.† *DDS 2501*

A. spinosus L.† *DDS 2156*

ANACARDIACEAE (Sumac/Cashew Family)

Rhus aromatica Ait. *DDS 1116*

R. copallina L. *DDS 993*

R. glabra L. *DDS 1002*

Toxicodendron radicans (L.) Kuntze [*Rhus radicans*] *DDS 1482*

T. toxicarium (Salisb.) Gillis [*Rhus toxicodendron*] *DDS 2283*

ANNONACEAE (Custard-Apple Family)

Asimina parviflora (Michx.) Dunal *DDS 1989*

A. triloba (L.) Dunal *DDS 1057*

APIACEAE [Umbelliferae] (Carrot/Parsley Family)

Angelica triquinata Michx. *DDS 1717*

Apium leptophyllum (Pers.) F. Muell. [*Cyclospermum leptophyllum*] *DDS 1387*

Chaerophyllum tainturieri Hook. *DDS 1342*

Cicuta maculato L. *DDS 1815*

Cryptotaenia canadensis (L.) DC. *DDS 3700*

Daucus carota L.† *DDS 843*

D. pusillus Michx. *DDS 2351*

Eryngium prostratum Nutt. *DDS 2376*

Hydrocotyle verticillata Thunb. *DDS 1446*

Osmorhiza claytonii (Michx.) Clarke *DDS 1432*

O. longistylis (Torr.) DC. *DDS 1481*

Ptilimnium capillaceum (Michx.) Raf. *DDS 2080*

Sanicula canadensis L. *DDS 1854*

S. gregoria Bickn. *DDS 1687*

S. marilandica L. *Whetstone 1532*

S. smallii Bickn. *DDS* 1691

Thaspium barbinode (Michx.) Nutt. *DDS 1251*

T. pinnatifidum (Buckl.) Gray *DDS 1389*

T. trifoliatum (L.) Gray var. flavum Blake *DDS 1501*

Tordlis arvensis (Hudson) Link† [*T. japonica*] *DDS 1817*

Trepocarpus aethusoe Nutt. *DDS* 2081

Zizia aptera (Gray) Fern. *DDS 5471*

APOCYNACEAE (Dogbane Family)

Amsonia tabernaemontana Walt. *DDS 3456*

Apocynum cannabinum L. *DDS* 5468

Vinco major L.† *DDS 1157*

AQUIFOLIACEAE (Holly Family)

Ilex ambigua var. *monticola* (Gray) Wunder. & Poppl. [*I. montana*] *DDS 1074*

I. longipes Chapm. [*I. decidua* var. *longipes*] *DDS 1066*

I. opaca Ait. *DDS 1089*

I. verticillata (L.) Gray *DDS* 3218

ARALIACEAE (Ginseng Family)

Aralia racemosa L.* S1 *DDS 5451*

A. spinosa L. *DDS* 963a

Hedera helix L.† *DDS 3477*

Panax quinquefolius L.* *xS4/3C DDS 5476*

ARISTOLOCHIACEAE (Birthwort Family)

Aristolochia serpentaria L. *DDS 3495*

A. tomentosa Sims *DDS* 2695

Hexastylis arifolia (Michx.) Small

var. ruthii (Ashe) Blomq. *DDS 1243*

H. shuttleworthii (Britt. & Baker) Small *DDS 1133*

ASCLEPIADACEAE (Milkweed Family)

Asclepias amplexicaulis Smith *DDS 1774*

A. quadrifolia Jacq. *DDS* 5462

A. tuberosa L. *DDS* 2000

A. variegata L. *DDS 1940*

A. verticillata L. *DDS* 5496

Cynanchum laeve (Michx.) Pers. *DDS 4338*

Matelea carolinensis (Jacq.) Woodson *DDS 1764a*

M. gonocarpa (Walt.) Shinn. *DDS 1968*

ASTERACEAE/COMPOSITAE (Aster Family)

Achillea millefolium L.† *DDS 5489*

Ambrosia artemisiifolia L. *DDS 808*

A. trifida L. *DDS 2804*

Antennaria plantaginifolia (L.) Richard. *DDS 1254*

A. solitaria Rydb. *DDS 1307*

Anthemis cotula L.† *DDS 1813*

Arctium minus (Hill) Bernh.† *DDS 2316*

Arnoglossum atriplicifolium (L.) H. Rob.

[*Cacalia atriplicifolia*] *DDS* 897

A. muhlenbergii (Sch.-Bip.) H. Rob.

[*Cacalia muhlenbergii*] *DDS 2078*

Aster concinnus Willd.* S1

[*A. laevis* var. *concinnus*] *DDS 6774*

A. concolor L. *DDS* 3282

A. cordifolius L. *DDS* 2054

A. divaricatus L. *DDS 2380*

A. dumosus L. *DDS* 969

A. hemisphericus Alex. *DDS 2818*

A. infirmus Michx. [*Doellingeria infirma*] *DDS* 2595

A. lateriflorus (L.) Britt. *DDS* 911

A. patens Ait. *DDS* 967

A. paternus Cronq. [*Sericocarpus asteroides*]

DDS 2176

A. pilosus Willd. *DDS 6789*

A. sagittifolius Wedem. *ex* Willd. *DDS 877*

A. shortii Lindl. *DDS 1024*

A. simplex Willd. [*A. lanceolatus*] *DDS 6777*

A. solidagineus Michx. [*Sericocarpus linifolius*]

DDS 2179

A. surculosus Michx.* S1 *DDS 6761*

A. undulatus L. *DDS 1077*

Bidens bipinnata L. *DDS 1003*

B. frondosa L. *DDS* 953

B. polylepis Blake *DDS 862*

Bigelowia nuttallii L. Anderson* S3 *xS2*

[*Chondrophora virgata*] *DDS 1148*

Calyptocarpus vialis Less.† *DDS 1385*

Carduus nutans L.† *DDS 1831*

Chrysanthemum leucanthemum L.†

[*Leucanthemum vulgare*] *DDS 1381*

Chrysopsis camporum Greene

[*Heterotheca camporum*] *DDS 846*

C. graminifolia (Michx.) Ell. [*Pityopsis graminifolia*;

Heterotheca graminifolia] *DDS 980*

C. mariana (L.) Ell. [*Heterotheca mariana*] *DDS 990*

Cirsium altissimum (L.) Spreng. [*Carduus altissimus*]

DDS 3139

C. discolor (Muhl.) Spreng. [*Carduus discolor*]

DDS 3275

C. horridulum Michx. [*Carduus spinosissimus*]

DDS 1377

C. vulgare (Savi) Tenore† [*Carduus lanceolatus*] *DDS 863*

Conyza canadensis (L.) Cronq. [*Erigeron canadensis*] *DDS* 2573

Coreopsis auriculata L. *DDS 1396*

C. grandiflora Hogg *DDS 2177*

C. lanceolata L. *DDS 4495*

C. major Walt. *DDS 1075*

C. pubescens Ell. *DDS 2288*

C. pulchra Boynt.* S2 *xSC DDS 4171*

C. tinctoria Nutt.† *DDS 7338*

C. tripteris L. *DDS 2674*

Cosmos bipinnatus Cav.† *DDS 2155*

C. sulphureus Cav.† *DDS 6767*

Crepis pulchra L.† *DDS 1604*

Echinacea purpurea (L.) Moench* *xS2* [Reported]

Eclipta alba (L.) Hassk.† [*E. prostrata*] *DDS 2732*

Elephantopus carolinianus Willd. *DDS* 895

E. tomentosus L. *DDS 991*

Erechtites hieraciifolia (L.) Raf. *DDS 813*

Erigeron annuus (L.) Pers. *DDS 854*

E. philadelphicus L. *DDS 1369*

E. pulchellus Michx. *DDS 1509*

E. strigosus Muhl. *DDS 1543*

Eupatorium album L. *DDS* 2328

E. aromaticum L. [*Ageratina aromaticum*] *DDS 3214*

E. capillifolium (Lam.) Small *DDS 1048*

E. coelestinum (L.) DC. [*Conoclinium coelestinum*] *DDS 867*

E. fistulosum Barrett [*Eupatoriadelphus fistulosus*] *DDS 890*

E. hyssopifolium L. *DDS* 977

E. incarnatum Walt. [*Fleischmannia incarnata*] *DDS 929*

E. perfoliatum L. *DDS* 2575

E. purpureum L. [*Eupatoriadelphus purpureus*] *DDS 2385*

E. rotundifolium L. *DDS 2352*

E. rugosum Houtt. [*Ageratina altissima*] *DDS 920*

E. serotinum Michx. *DDS 814*

Facelis retusa (Lam.) Sch.-Bip.† *DDS 1775*

Gaillardia pulchella Foug.† *DDS 1882*

Gnaphalium obtusifolium L. *DDS* 996

G. purpureum L. [*Gamochaeta purpureum*] *DDS 1272*

Haplopappus divaricatus (Nutt.) Gray *DDS 1014*

Helenium amarum (Raf.) H. Rock *DDS 831*

H. autumnale L. *DDS 7391*

H. flexuosum Raf. *DDS 2532*

Helianthus atrorubens L. *DDS 1018*

H. divaricatus L. *DDS 1022*

H. hirsutus Raf. *DDS 2150*

H. longifolius Pursh* S1S2 *xS? DDS 2362*

H. microcephalus T. & G. *DDS 966*

Heliopsis gracilis Nutt. *DDS 2583*

H. helianthoides (L.) BSP *DDS 2545*

Heterotheca subaxillaris (Lam.) Britt. & Rusby† *DDS 6799*

Hieracium gronovii L. *DDS 1726*

H. venosum L. *DDS 1423*

Hypochoeris radicata L.† *DDS 1889*

Krigia biflora (Walt.) Blake *DDS 1517*

K. dandelion (L.) Nutt. *DDS 1383*

K. oppositifolia Raf. *DDS 1273*

K. virginica (L.) Willd. *DDS 1587*

Kuhnia eupatorioides L. [*Brickellia eupatorioides*] *DDS 1035*

Lactuca canadensis L. *DDS 2088*

L. floridana (L.) Gaertn. *DDS 852*

L. serriola L.† [*L. scariola*] *DDS 2373*

Liatris graminifolia Willd. *DDS 6770*

L. microcephiala (Small) K. Schum. *DDS 2368*

L. squarrulosa Michx. [*L. earlei*] *DDS 1020*

Marshallia trinervia (Walt.) Trel. *ex* B. & C.* S3 *Whetstone 15,289*

Matricaria chamomilla L.† *DDS 2024*

Mikania scandens (L.) Willd. *DDS 2589*

Pluchea camphorata (L.) DC. *DDS 913*

Polymnia canadensis L. *DDS 2330*

P. uvedalia L. [*Smallanthus uvedalia*] *DDS 2321*

Prenanthes altissima L. *DDS 3216*

P. serpentaria Pursh *DDS 3141*

Pyrrhopappus carolinianus (Walt.) DC. *DDS 1735*

Ratibida columnifera (Nutt.) Woot. & Standl † *DDS 1881*

Rudbeckia fulgida Ait. *DDS 2635*

R. heliopsidis T. & G.* S2 *xC2 DDS 2568*

R. hirta L. var. *hirta DDS 2069*

R. hirta var. *pulcherrima* Farw.† [*R. serotina*] *DDS 1739*

R. laciniata L. *DDS 4331*

R. triloba L. *DDS 2436*

Senecio anonymus Wood [*S. smallii*] *DDS 1494*

S. glabellus Poir. *DDS 1413*

S. obovatus Muhl. *ex* Willd. *DDS 1297*

Silphium asteriscus L. var. *scabrum* Nutt. [*S. dentatum* var. *gatesii*] *DDS 2030*

S. brachiatum Gatt.* S2 *xC2 DDS 10,513*

S. compositum Michx. *DDS 2442*

S. mohrii Small* S1 *xSR DDS 5500*

S. trifoliatum L. var. *latifolium* Gray [*S. laevigatum*] *DDS 880*

Solidago arguta Ait., var. *caroliniana* Gray *DDS 1028*

S. caesia L. *DDS 1026*

S. canadensis L. var. *scabra* (Muhl.) T. & G. [*S. altissima*] *DDS 998*

S. curtisii T. & G. *DDS 876*

S. erecta Pursh *DDS 1033*

S. gigantea Ait. *DDS 2683*

S. nemoralis Ait. var. haleana Fern. *DDS 1038*

S. odora Ait. *DDS 976*

S. rugosa Mill. *DDS 2744*

S. ulmifolia Muhl. *DDS 2713*

Soliva pterosperma (Juss.) Less.† *DDS 1891*

Sonchus asper (L.) Hill† *DDS 1361*

S. oleraceus L.† *DDS 1918*

Tagetes erecta L.† *DDS 2277*

Taraxacum officinale Wiggers† *DDS 1101*

Verbesina alternifolia (L.) Britt. *ex* Kearn. *DDS 3201*

V. occidentalis (L.) Walt. *DDS 857*

V. virginica L. *DDS 1027*

Vernonia flaccidifolia Small *DDS 2625*

V. gigantea (Walt.) Trel. *ex* Bran. & Cov. [*V. altissima*] *DDS 860*

Xanthium strumarium L. var. *glabratum* (DC.) Cr † *DDS 1045*

BALSAMINACEAE (Touch-me-not Family)

Impatiens capensis Meerb *DDS 840*

BERBERIDACEAE (Barberry Family)

Caulophyllum thalictroides (L.) Michx. *DDS 1421*

Jeffersonia diphylla (L.) Pers.* S2 *DDS 10,511*

Nandina domestica Thunb.† *DDS 2028*

Podophyllum peltatum L. *DDS 1122*

BETULACEAE (Birch Family)

Alnus serrulata (Ait.) Willd. *DDS 839*

Betula lenta L. *DDS 6754*

B. nigra L. *DDS 1628*

Carpinus caroliniana Walt. *DDS 961*

Ostrya virginiana (Mill.) K. Koch *DDS 934*

BIGNONIACEAE (Bignonia Family)

Bignonia capreolata L. [*Anisostichus capreolata*] *DDS 1429*

Campsis radicans (L.) Seem. *DDS 1013*

Catalpa bignonioides Walt. *DDS 2025*

BORAGINACEAE (Borage Family)

Cynoglossum virginianum L. *DDS 1404*

Heliotropium indicum L.† *DDS 2425*

Lithospermum canescens (Michx.) Lehm. *DDS 927*

L. tuberosum Rugel *ex* DC. *Reported by L. Reynolds*

Mertensia virginica (L.) Pers. *DDS 1246*

Myosotis macrosperma Engelm. *DDS 1102*

Onosmodium virginianum (L.) A. DC. *DDS 1765*

BRASSICACEAE [Cruciferae] (Mustard Family)

Arabidopsis thaliana (L.) Heynh.† *DDS 1151*

Arabis canadensis L. *DDS 5472*

A. laevigata (Muhl. *ex* Willd.) Poir. *DDS 1099*

Barbarea verna (Mill.) Asch.† *DDS 3483*

Brassica juncea (L.) Coss.† *DDS 1841*

B. napus L.† [*L. rapa; L. campestris*] *DDS 1183*

B. nigra (L.) K. Koch† *DDS 1800*

Capsella bursa-pastoris (L.) Medic.† *DDS 1174*

Cardamine hirsuta L.† *D DS 1004*

C. pensylvanica Muhl. *ex* Willd. *DDS 1412*

Dentaria diphylla Michx. [*Cardamine diphylla*] *DDS 1293*

D. heterophylla Nutt. [*Cardamine angustata*] *DDS 1115*

D. laciniata Muhl. [*Cardamine concatenata*] *DDS 1082*

Draba brachycarpa Nutt. *ex* T. & G. *DDS 1106*

D. verna L.† *DDS 1159*

Lepidium virginicum L. *DDS 972*

Nasturtium officinale R. Br.† *DDS 7392*

Rorippa palustris (L.) Besser [*R. islandica*] *DDS 1512*

Sibara virginica (L.) Rollins *DDS 7324*

Sisymbrium officinale (L.) Scopoli† *DDS 1463*

BUXACEAE (Boxwood Family)

Pachysandra procumbens Michx.* S2S3 *DDS 4072a*

CACTACEAE (Cactus Family)

Opuntia humifusa Raf. [*O. compressa*] *DDS 1184*

CALLITRICHACEAE (Water-starwort Family)

Callitriche heterophylla Pursh *DDS 1411*

CALYCANTHACEAE (Strawberry-shrub Family)

Calycanthus floridus L. [*C. mohrii*] *DDS 1720*

CAMPANULACEAE (Bellflower Family)

Campanula americana L. *DDS 2402*

Lobelia cardinalis L. *DDS 869*

L. inflata L. *DDS 2141*

L. puberula Michx. *DDS 881*

L. spicata Lam. *DDS 5501*

Triodanis biflora (Ruiz & Pavon) Greene [*Specularia biflora*] *DDS 1609*.

T. perfoliata (L.) Nieuwl. [*Specularia perfoliata*] *DDS 1594*

CANNABANACEAE (Hemp Family)

Humulus japonicus Sieb. & Zucc.† *DDS 2789*

CAPRIFOLIACEAE (Honeysuckle Family)

Diervilla rivularis Gatt.* S?
[*D. sessilifolia* var. *rivularis*] *DDS 2106*

Lonicera japonica Thunb.† *DDS 1041*

L. sempervirens L. *DDS 1909*

Sambucus canadensis L. *DDS*

Symphoricarpus orbiculatus Moench *DDS 923*

Viburnum acerifolium L. *DDS 1058*

V. cassinoides T. & G. [*V. nudum* var. *cassinoides*]
DDS 1698

V. dentatum L. *DDS 3206*

V. rufidulum Raf. *DDS 1245*

CARYOPHYLLACEAE (Pink Family)

Arenaria serpyllifolia L.† *DDS 1887*

Cerastium glomeratum Thuill.† [*C. viscosum*]
DDS 1164

Dianthus armeria L.† *DDS 1998*

Minuartia glabra (Michx.) Mattf.
[*Arenaria groenlandica* var. *glabra*] *DDS 1286*

Sagina decumbens (Ell.) T. & G. *DDS 1264*

Silene antirrhina L. *DDS 1772*

S. caroliniana Walt. spp. wherryi (Small) Cl.* S1S2
DDS 1397

S. ovata Pursh* S1 xC2 *DDS 3300*

S. stellata (L.) Ait. *f. DDS 2386*

S. virginica L. *DDS 1337*

Stellaria media (L.) Cyr.† *DDS 1111*

S. pubera Michx. *DDS 1126*

CELASTRACEAE (Bittersweet Family)

Euonymus americanus L. *DDS 909*

CERATOPHYLLACEAE (Hornwort Family)

Ceratophyllum demersum L. *DDS 948*

CHENOPODIACEAE (Goosefoot Family)

Chenopodium album L.† *DDS 1042*

C. ambrosioides L.† *DDS 4335*

CISTACEAE (Rock-rose Family)

Lechea racemulosa Michx. *DDS 2281*

CLUSIACEAE (St. John's-wort Family)
[Hypericaceae]

Hypericum gentianoides (L.) BSP *DDS 2367*

H. hypericoides (L.) Crantz [*Ascyrum hypericoides*]
DDS 875

H. mutilum L. *DDS 887*

H. perforatum L.† *DDS 859*

H. prolificum L. *DDS 1621*

H. punctatum Lam. *DDS 2282*

H. stans (Michx.) P. Adams & Robson
[*H. crux-andreae; Ascyrum stans*] *DDS 2559*

H. stragalum P. Adams & Robson
[*Ascyrum hypericoides* var. *muticaule*] *DDS 1078*

Triadenum walteri (Gmel.) Gl. [*Hypericum walteri*]
DDS 885

CONVOLVULACEAE (Morning-glory Family)

Calystegia sepium (L.) R. Br. *DDS 838*

Dichondra carolinensis Michx. *DDS 2642*

Ipomoea coccinea L.† *DDS 6765*

I. hederacea (L.) Jacq.† *DDS 1021*

I. lacunosa L. *DDS 837*

I. pandurata (L.) Meyer *DDS 2072*

I. purpurea (L.) Roth† *DDS 2497*

I. quamoclit L.† *DDS 2782*

Stylisma humistrata (Walt.) Chapm. [*Bonamia humistrata*] *DDS 2350*

CORNACEAE (Dogwood Family)

Cornus amomum Mill. *DDS 937*

C. florida L. *DDS 959*

C. foemina Mill. [*C. stricta*] *DDS 1619*

CRASSULACEAE (Stonecrop Family)

Diamorpha smallii Britt.* xS3 [*Sedum smallii*] *DDS 1185*

Sedum ternatum Michx. *DDS 1132*

CUCURBITACEAE (Cucumber Family)

Citrullus vulgaris Schrad. *ex* Eckl. & Zeyh.† [*C. lanatus*] *DDS 2296*

Melothria pendula L. *DDS 1008*

Sicyos angulatus L. *DDS 2453*

CUSCUTACEAE (Dodder Family) [Convolvulaceae]

Cuscuta campestris Yunck. *DDS 2653*

C. compacta Juss. *DDS 878*

C. gronovii Willd. *ex* R. & S. *DDS 2765*

C. harperi Small* S2 xC2 *DDS 2360*

DIAPENSIACEAE (Diapensia Family)

Galax urceolata (Poir.) Brumm. [*G. aphylla*] *DDS 1714*

EBENACEAE (Ebony Family)

Diospyros virginiana L. *DDS 963*

ERICACEAE (Heath Family)

Epigaea repens L. *DDS 1308*

Kalmia latifolia L. *DDS 1425*

Leucothoe racemosa (L.) Gray *DDS 1638*

Oxydendrum arboreum (L.) DC. *DDS 1067*

Rhododendron arborescens (Pursh) Torr. *DDS 1693*

R. canescens (Michx.) Sweet *DDS 1324*

R. catawbiense Michx. *DDS 1319*

Vaccinium arboreum Marsh. *DDS 1766*

V. corymbosum L. [*V. fuscatum; V. atrococcum*] *DDS 1317*

V. elliottii Chapm. *DDS 2379*

V. pallidum Ait. [*V. vacillans*] *DDS 1751*

V. stamineum L. *DDS 1407*

EUPHORBIACEAE (Spurge Family)

Acalypha gracilens Gray *DDS 815*

A. ostryaefolia Ridd. *DDS 1043*

A. rhomboidea Raf. *DDS 823*

A. virginica L. *DDS 2167*

Chamaesyce humistrata (Engelm.) Small *DDS 810*

C. maculata (L.) Small [*Euphorbia supina*] *DDS 1011*

C. nutans (Lag.) Small [*Euphorbia maculata*] *DDS 809*

C. prostrata (Ait.) Small† [*Euphorbia chamaesyce*] *DDS 2162*

Croton capitatus Michx. *DDS 850*

C. glandulosus L. var. septentrionalis Muell-Arg. *DDS 2616*

C. monathogynus Michx. *DDS 2443*

Crotonopsis elliptica Willd. [*Croton willdenowii*] *DDS 2366*

Euphorbia corollata L. *DDS 983*

E. dentata Michx.† [*Poinsettia dentata*] *DDS 2504*

E. mercurialina Michx. *DDS 1632*

E. pubentissima Michx. [*E. corollata* var. *zinniiflora*] *DDS 1705*

Tragia urticifolia Michx. *DDS 2639*

FABACEAE/LEGUMINOSAE (Pea/Bean Family)

Albizia julibrissin Durazz.† *DDS 1620*

Amorpha fruticosa L. *DDS 1012*

Amphicarpaea bracteata (L.) Fern. [*Amphicarpa bracteata*] *DDS 898*

Apios americana Medic. *DDS 2687*

Centrosema virginianum (L.) Benth. *DDS 2344*

Cercis canadensis L. *DDS 939*

Chamaecrista fasciculata (Michx.) Greene [*Cassia fasciculata*] *DDS 844*

C. nictitans (L.) Moench [*Cassia nictitans*] *DDS 836*

Clitoria mariana L. *DDS 1950*

Coronilla varia L.† *DDS 1946*

Crotalaria sagittalis L. *DDS 1951*

C. spectabilis Roth† *DDS 6758*

Desmodium canescens (L.) DC. *DDS 2553a*

D. ciliare (Muhl. *ex* Willd.) DC. *DDS 2755*

D. glabellum (Michx.) DC. *DDS 832*

D. glutinosum (Muhl. *ex* Willd.) Wood *DDS 2301*

D. laevigatum (Nutt.) DC. *DDS 3102*

D. marilandicum (L.) DC. *DDS 2754*

D. nudiflorum (L.) DC. *DDS 2302*

D. paniculatum (L.) DC. *DDS 907*

D. paucíflorum (Nutt.) DC. *DDS 2404*

D. perplexum Schub. *DDS 2779*

D. rotundifolium DC. *DDS 2808*

D. viridiflorum (L.) DC. *DDS 3092*

Galactia volubilis (L.) Britt. *DDS 2274*

Gleditsia triacanthos L. *DDS 1742*

Kummerowia stipulacea (Maximowicz) Schindl.† [*Lespedeza stipulacea*] *DDS 2658*

K. striata (Thunb.) Schindl.† [*Lespedeza striata*] *DDS 2394*

Lathyrus hirsutus L.† *DDS 1599*

Lespedeza cuneata (Dumont) G. Don† *DDS 812*

L. hirta (L.) Hornem. *DDS 2817*

L. procumbens Michx. *DDS 2756*

L. repens (L.) Bart. *DDS 2659*

L. stuevei Nutt. *DDS 3083*

L. virginica (L.) Britt. *DDS 2746*

Medicago lupulina L.† *DDS 1265*

Melilotus alba Desr.† *DDS 2052*

M. officinalis (L.) Pallas† *DDS 1842*

Orbexilum pedunculatum (Mill.) Rydb. [*Psoralea psoralioides*] *DDS 1745*

Phaseolus polystachios (L.) BSP *DDS 2685*

Pueraria lobata (Willd.) Ohwi† *DDS 1032*

Rhynchosia tomentosa (L.) Hook. & Arn. *DDS 2286*

Robinia hispida L. var. rosea Pursh [*R. boyntonii*] *DDS 5463*

R. pseudoacacia L. *DDS 992*

Schrankia microphylla (Soland. *ex* Smith) Macbride *DDS 1955*

Senna marilandica (L.) Link [*Cassia marilandica*] *DDS 915*

S. obtusifolia (L.) Irwin & Barneby† [*Cassia obtusifolia*] *DDS 845*

S. occidentalis (L.) Link† [*Cassia occidentalis*] *DDS 2766*

Stylosanthes biflora (L.) BSP *DDS 2073*

Tephrosia spicata (Walt.) T. & G. *DDS 2013*
T. virginiana (L.) Pers. *DDS 2046*
Trifolium campestre Schreb.† *DDS 1363*
T. dubium Sibth.† *DDS 1368*
T. incarnatum L.† *DDS 1359*
T. pratense L.† *DDS 824*
T. repens L.† *DDS 1266*
Vicia caroliniana Walt. *DDS 1136*
V. grandiflora Scop.† *DDS 1671*
V. sativa L. ssp. nigra (L.) Ehrend.† [*V. angustifolia*] *DDS 1763*
V. tetrasperma (L.) Moench† *DDS 1414*
V. villosa Roth ssp varia (Host) Corb.† [*V. dasycarpa*] *DDS 1416*
Wisteria frutescens (L.) Poir. *DDS 1655*
W. sinensis (Sims) Sweet† *DDS 3491*

FAGACEAE (Beech Family)
Castanea dentata (Marsh.) Borkh. *DDS 1068*
Fagus grandifolia Ehrh. *DDS 962*
Quercus alba L. *DDS 1001*
Q. coccinea Muenchh. *DDS 1732*
Q. falcata Michx. *DDS 930*
Q. laurifolia Michx. *DDS 5456*
Q. marilandica Muenchh. *DDS 989*
Q. montana Willd. [*Q. prinus*] *DDS 974*
Q. muehlenbergii Engelm. [*Q. prinoides* var *acuminata*] *DDS 3513*
Q. nigra L. *DDS 965*
Q. phellos L. *DDS 1050*
Q. rubra L. *DDS 5475*
Q. shumardii Buckl. *DDS 942*
Q. stellata Wang. *DDS 971*
Q. velutina Lam., *DDS 1079*

FUMARIACEAE (Fumatory Family)
Dicentra cucullaria (L.) Bernh.* S2 *DDS 5078*

GENTIANACEAE (Gentian Family)
Frasera carolinensis Walt.* S1S2 [*Swertia caroliniensis*] *DDS 3510*
Obolaria virginica L. *DDS 3403*
Sabatia angularis (L.) Pursh *Reported by L. Reynolds*
S. capitata (Raf.) Blake* S2 *DDS 2490*

GERANIACEAE (Geranium Family)
Erodium cicutarium (L.) L'Her.† *DDS 1173*
Geranium carolinianum L. *DDS 1270*
G. dissectum L.† *DDS 7327*
G. maculatum L. *DDS 1251*
G. molle L.† *DDS 3475*

GROSSULARIACEAE (Gooseberry Family) [Saxifagaceae]
Itea virginica L. *DDS 882*
Ribes curvatum Small* S2 *xSH DDS 1094*

HALORAGACEAE (Water-milfoil Family)
Myriophyllum aquaticum (Vell.) Verd.† [*M. brasiliense*] *DDS 1459*
M. spicatum L.† *DDS 1649*

HAMAMELIDACEAE (Witch-hazel Family)
Hamamelis virginiana L. *DDS 1444*
Fothergilla major (Sims) Lodd.* S2 *DDS 3453*
Liquidambar styraciflua L. *DDS 958*

HIPPOCASTANACEAE (Horse-chestnut Family)
Aesculus flava Soland. [*A. octandra*] *DDS 5454*

A. pavia L. *DDS 1143*

A. sylvatica Bartr. *Reported by Linda Reynolds*

HYDRANGEACEAE (Hydrangea Family)
[Saxifragaceae]

Hydrangea arborescens L. *DDS 1047*

H. cinerea Small [*H. arborescens* var. *discolor*] *DDS 1922*

H. quercifolia Bartr. *DDS 910*

Philadelphus hirsutus Nutt. *DDS 1476*

P. inodorus L. *DDS 1450*

HYDROPHYLLACEAE (Waterleaf Family)

Hydrolea quadrivalvis Walt. *DDS 2467*

Hydrophyllum canadense L. *DDS 1688*

Nemophila aphylla (L.) Brumm. [*N. microcalyx*] *DDS 1484*

Phacelia bipinnatifida Michx. *DDS 3455*

JUGLANDACEAE (Walnut Family)

Carya cordiformis (Wang.) K. Koch *DDS 3488*

C. glabra (Mill.) Sweet [Inc. *C. ovalis*] *DDS 940*

C. illinoiensis (Wang.) K. Koch† *DDS 6807*

C. ovata (Mill.) K. Koch var. *australis* (Ashe) Little [*C. carolinae-septentrionalis*] *DDS 1069*

C. pallida (Ashe) Engl. & Graeb. *DDS 4167*

C. tomentosa (Poir.) Nutt. *DDS 936*

Juglans cinerea L.* S1 *xS?/C2 DDS 2113*

J. nigra L. *DDS 2700*

LAMIACEAE/LABIATAE (Mint Family)

Collinsonia canadensis L. *DDS 3115*

C. tuberosa Michx. *DDS 6768*

Glechoma hederacea L.† *DDS 2475*

Hedeoma pulegioides (L.) Pers. *DDS 2821*

Lamium amplexicaule L.† *DDS 1105*

L. purpureum L.† *DDS 1158*

Lycopus americanus Muhl. *ex* Bart. *DDS 4327*

L. rubellus Moench *DDS 886*

L. virginicus L. *DDS 902*

Mentha piperita L.† *DDS 4332*

Monarda citriodora Cerv. *ex* Lag.† *DDS 2172*

M. clinopodia L.* S2 *xS3 DDS 1684*

M. fistulosa L. *DDS 1810*

Perilla frutescens (L.) Britt.† *DDS 2809*

Prunella vulgaris L.† *DDS 2142*

Pycnanthemum incanum (L.) Michx. *DDS 938*

P. tenuifolium Schrad. *DDS 4168*

Salvia lyrata L. *DDS 1358*

S. urticifolia L. *DDS 1806*

Scutellaria elliptica Muhl. *DDS 1928*

S. incana Biehler *DDS 2564*

S. integrifolia L. *DDS 1995*

S. lateriflora L. *DDS 2590*

S. ovata Hill *DDS 928*

S. pseudoserrata Epl. *DDS 1654*

Teucrium canadense L. *DDS 2140*

Trichostema dichotomum L. *DDS 2668*

T. setaceum Houtt. *DDS 3110*

LAURACEAE (Laurel Family)

Lindera benzoin (L.) Blume *DDS 1090*

Sassafras albidum (Nutt.) Nees *DDS 985*

LENTIBULARIACEAE (Bladderwort Family)

Utricularia biflora Lam. *DDS 2408*

LINACEAE (Flax Family)

Linum medium (Planch.) Britt.
var. *texanum* (Planch.) Fern.
[*L. virginianum* var. *medium*] *DDS 2157*

L. striatum Walt. *DDS 1962*

LOGANIACEAE (Logania Family)

Gelsemium sempervirens (L.) Ait. *f. DDS 1287*

Polypremum procumbens L. *DDS 2395*

Spigelia marilandica L. *DDS 1670*

LORANTHACEAE (Showy Mistletoe Family)

Phoradendron serotinum (Raf.) M.C. Johnst.
DDS 3447

LYTHRACEAE (Loosestrife Family)

Ammania coccinea Rottb. *DDS 6794*

Rotala ramosior (L.) Koehne *DDS 946*

MAGNOLIACEAE (Magnolia Family)

Liriodendron tulipifera L. *DDS 935*

Magnolia acuminata L. *DDS 1054*

MALVACEAE (Mallow Family)

Hibiscus militaris Cav. *DDS 2308*

H. moscheutos L. *DDS 883*

Modiola caroliniana (L.) G. Don *DDS 1354*

Sida rhombifolia L.† *DDS 1051*

S. spinosa L.† *DDS 2371*

MELASTOMATACEAE (Melastome Family)

Rhexia mariana L. *DDS 2143*

R. virginica L. *DDS 2558*

MELIACEAE (Mahogany Family)

Melia azedarach L.† *DDS 6788*

MENISPERMACEAE (Moonseed Family)

Cocculus carolinus (L.) DC. *DDS 2082*

MOLLUGINACEAE (Carpetweed Family)
[Aizoaceae]

Mollugo verticillata L.† *DDS 2511*

MONOTROPACEAE (Indian Pipe Family)
[Ericaceae]

Monotropa hypopithys L.* S2 *xS1 DDS 2066*

M. uniflora L. *Reported by Linda Reynolds*

MORACEAE (Mulberry Family)

Broussonetia papyrifera (L.) Vent.† *DDS 2614*

Maclura pomifera (Raf.) Schneid.† *DDS 2332*

Morus rubra L. *DDS 1677*

NELUMBONACEAE (Lotus-lily Family)

Nelumbo lutea (Willd.) Pers. *Reported by L. Reynolds*

NYSSACEAE [Cornaceae] (Sour Gum Family)

Nyssa aquatica L. *DDS 1612*

N. sylvatica Marsh. *DDS 1700*

OLEACEAE (Olive Family)

Chionanthus virginicus L. *DDS 1583*

Forestiera ligustrina (Michx.) Poir. *DDS 3517*

Fraxinus americana L. *DDS 2517*

F. pensylvanica Marsh., *DDS 2119*

F. quadrangulata Michx. *DDS 10,512*

Ligustrum sinense Lour.† *DDS 848*

ONAGRACEAE (Evening-primrose Family)

Circaea lutetiana (L.) Asch. & Mag.
ssp. canadensis (L.) Asch. & Mag. *DDS 2044*

Gaura filipes Spach *DDS 2637*

Ludwigia alternifolia L. *DDS 2318*

L. decurrens Walt. *DDS 906*

L. leptocarpa (Nutt.) Hara *DDS 822*

L. palustris (L.) Ell. *DDS 947*

L. peploides (HBK) Raven *DDS 1458*

L. uruguayensis (Camb.) Hara *DDS 2033*

Oenothera biennis L. *DDS 2374*

O. laciniata Hill *DDS 1371*

O. speciosa Nutt.† *DDS 1799*

OROBANCHACEAE (Broomrape Family)

Conopholis americana (L.) Wallroth *DDS 1643*

Epifagus virginiana (L.) Bart. *DDS 1938*

OXALIDACEAE (Wood-sorrel Family)

Oxalis corniculato L.† *DDS 1108*

O. dillenii Jacq. [*O. stricta* misapplied] *DDS 1762*

O. priceae Small ssp. *colorea* (Small) Eiten
[*O. florida* var. *recurva*] *DDS 1315*

O. stricta L. [*O. europaea*] *DDS 901*

O. violacea L. *DDS 1166*

PAPAVERACEAE (Poppy Family)

Papaver rhoeas L.† *DDS 5483*

Sanguinaria canadensis L. *DDS 1123*

PASSIFLORACEAE (Passion-flower Family)

Passiflora incarnata L. *DDS 856*

P. lutea L. *DDS 2349*

PHRYMACEAE [Verbenaceae] (Lopseed Family)

Phryma leptostochya L. *DDS 2303*

PHYTOLACCACEAE (Pokeweed Family)

Phytolacca americana L. *DDS 821*

PLANTAGINACEAE (Plantain Family)

Plantago aristota Michx. *DDS 2012*

P. heterophylla Nutt. *DDS 7331*

P. lanceolota L.† *DDS 1347*

P. rugelli Dcne. *DDS 1888*

P. virginica L. *DDS 1180*

PLATANACEAE (Plane-tree Family)

Platanus occidentalis L. *DDS 1427*

POLEMONIACEAE (Phlox Family)

Phlox amoena Sims *DDS 1588*

P. divaricata L. *DDS 1252*

P. drummondii Hook.† *DDS 1738*

P. glaberrima L. [*P. carolina*] *DDS 1685*

P. maculata L. *DDS 6785*

P. nivalis Lodd. *DDS 1163*

POLYGALACEAE (Milkwort Family)

Polygala curtisii Gray *DDS 1749*

P. polygama Walt. *DDS 1706*

POLYGONACEAE (Buckwheat Family)

Polygonum aviculare L.† *DDS 2171*

P. caespitosum Blume
var. *longisetum* (DeBruyn) Stewart† *DDS 899*

P. hydropiper L.† *DDS 2409*

P. hydropiperoides Michx. *DDS 829*

P. lapathifolium L.† *DDS 2649*

P. pensylvanicum L. *DDS 817*

P. persicaria L.† *DDS 2435*

P. punctatum Ell. *DDS 954*

P. sagittatum L. *DDS 2107*

P. scandens L. var *scandens DDS 3159*

P. scandens var. *cristatum* (Engelm. & Gray) Gl. *DDS 2800*

P. setaceum Baldw *ex* Ell. *DDS 4329*

Rumex acetosella L.† *DDS 1375*

R. altissimus Wood *DDS 1617*

R. conglomeratus Murr.† *DDS 1836*

R. crispus L.† *DDS 1346*

R. obtusifolius L.† *DDS 4074*

Tovara virginiana (L.) Raf. [*Polygonum virginiana*] *DDS 2622*

PORTULACACEAE (Purslane Family)

Claytonia virginica L. *DDS 1085*

Talinum mengesii W. Wolf* S2S3 *x3C DDS 1879*

PRIMULACEAE (Primrose Family)

Dodecatheon meadia L. *DDS 3504*

Lysimachia ciliata L. *DDS 5492*

L. lanceolata Walt. *DDS 2096*

L. nummularia L.† *DDS 3405*

L. quadrifolia L. *DDS 5473*

PYROLACEAE (Wintergreen Family) [Ericaceae]

Chimaphila maculata (L.) Pursh *DDS 1092*

RANUNCULACEAE (Buttercup/Crowfoot Family)

Actaea pachypoda Ell. *DDS 5076*

Anemone acutiloba (D.C.) Lawson [*Hepatica acutiloba*; *H. nobilis* var. *acuta*] *DDS 1112*

A. americana (D.C.) Hara [*Hepatica americana*; *H. nobilis* var. *obtusa*] *DDS 1142*

A. quinquefolia L. *DDS 1137*

A. virginiana L. *DDS 1807*

Aquilegia canadensis L. *DDS 7395*

Cimicifuga racemosa Nutt. *DDS 1250*

Clematis terniflora DC.† [*C. dioscoreifolia*] *DDS 835*

C. virginiana L. *DDS 861*

Consolida ambigua (L.) Ball & Heyw.† [*Delphinium ajacis*] *DDS 1883*

Delphinium tricorne Michx. *DDS 1281*

Enemion biternatum Raf.* S2 *xS1* [*Isopyrum biternatum*] *Reported by L. Reynolds*

Hydrastis canadensis L.* S2 *x3C* *Reported by L. Reynolds*

Ranunculus arbortivus L. *DDS 1103*

R. arvensis L.† *DDS 7325*

R. bulbosus L.† *DDS 7326*

R. hispidus Michx. var. *hispidus DDS 1129*

R. hispidus var. *nitidus* (Ell.) T. Duncan [*R. carolinianus*] *DDS 1451*

R. parviflorus L.† *DDS 1462*

R. pusillus Pour. *DDS 1417*

R. recurvatus Pour. *DDS 1433*

R. sardous Crantz† *DDS 1910*

Thalictrum dioicum L. *DDS 3507*

T. thalictroides (L.) Boivin [*Anemonella thalictroides*] *DDS 1110*

Xanthorhiza simplicissima Marsh. *DDS 1138*

RHAMNACEAE (Buckthorn Family)

Berchemia scandens (Hill) K. Koch *DDS 1829*

Ceanothus americanus L. *DDS 1911*

Rhamnus caroliniana Walt. *DDS 921*

ROSACEAE (Rose Family)

Agrimonia microcarpa Wallr. [*A. pubescens* var. *microcarpa*] *DDS 2477*

A. rostellata Wallr. *DDS 2323*

Amelanchier arborea (Michx.) Fern.* *xS1 DDS 1119*

Aronia arbutifolia (L.) Ell. [*Sorbus arbutifolia*] *DDS 1316*

Aruncus dioicus (Walt.) Fern. *DDS 2102*

Crataegus aprica Beadle [*C. flava auctt. non* Aiton] *DDS 10,578*

C. calpodendron (Ehrh.) Medic. *DDS 5464*

C. gattingeri Ashe *DDS 10,583*

C. intricata Lange *DDS 5450*

C. marshallii Eggl. *DDS 1709*

C. mollis (T. & G.) Scheele *DDS 10,579*

C. pulcherrima Ashe* S? *DDS 1592*

C. spathulata Michx. *DDS 1053*

C. uniflora Muenchh. *DDS 1753*

Duchesnea indica (Andrz.) Focke† *DDS 1155*

Geum canadense Jacq. *DDS 2007*

G. virginianum L.* S1? *xS1 DDS 2726*

Malus angustifolia (Ait.) Michx. *Reported by L. Reynolds*

M. pumila Mill.† *DDS 5482*

Physocarpus opulifolius (L.) Maxim. *DDS 1613*

Porteranthus stipulatus (Muhl.) Britt. [*Gillenia stipulata*] *DDS 1935*

P. trifoliatus (L.) Britt. [*Gillenia trifoliata*] *DDS 1716*

Potentilla canadensis L. *DDS 1306*

P. simplex Michx. *DDS 1344*

Prunus angustifolia Marsh. *DDS 1121*

P. mexicana Wats. [*P. americana* var. *lanata*] *DDS 5074*

P. persica (L.) Batsch† *DDS 1161*

P. serotina Ehrh. *DDS 1410*

Pyrus communis L.† *DDS 3467*

Rosa carolina L. *DDS 1725*

R. multiflora Thunb.† *DDS 1743*

R. palustris Marsh. *DDS 5487*

R. setigera Michx. *DDS 1830*

R. wichuraiana Crep.† *DDS 1756*

Rubus argutus Link, [*R. betulifolius*] *DDS 1335*

R. bifrons Vest† *DDS 1421*

R. flagellaris Willd. [*R. enslenii*] *DDS 1333*

RUBIACEAE (Madder/Coffee Family)

Cephalanthus occidentalis L. *DDS 2311*

Diodia teres Walt. *DDS 2446*

D. virginiana L. *DDS 830*

Galium aparine L. *DDS 1175*

G. circaezans Michx. *DDS 1686*

G. obtusum Bigel. *DDS 2588*

G. pedemontanum All.† *DDS 1814*

G. pilosum Ait. *DDS 2285*

G. tinctorium L. *DDS 1963*

Houstonia caerulea L. [*Hedyotis caerulea*] *DDS 1118*

H. purpurea (L.) T. & G. [*Hedyotis purpurea*] *DDS 1596*

H. pusilla Schoepf [*Hedyotis crassifolia*] *DDS 1107*

Mitchella repens L. *DDS 1288*

Richardia scabra L.† *DDS 4342*

Sherardia arvensis L.† *DDS 1268*

SALICACEAE (Willow Family)

Populus deltoides Marsh. *DDS 6763*

Salix nigra Marsh. *DDS 1332*

SAPOTACEAE (Sapodilla Family)

Sideroxylon lycioides L. [*Bumelia lycioides*] *DDS 1284*

SAURURACEAE (Lizard's-tail Family)

Saururus cernuus L. *DDS 1838*

SAXIFRAGACEAE (Saxifrage Family)

Heuchera americana L. *DDS 1582*

H. villosa Michx. *DDS 918*

Penthorum sedoides L. *DDS 892*

Saxifraga virginiensis Michx. *DDS 1130*

Tiarella cordifolia L. var. *collina* Wherry *DDS 1253*

SCROPHULARIACEAE (Figwort Family)

Agalinis obtusifolia Raf. [*A. tenella*] *DDS 2745*

A. purpurea (L.) Penn. *DDS 2796*

Aureolaria flava (L.) Farw. *DDS 3090*

A. virginica (L.) Penn. *DDS 922*

Castilleja coccinea (L.) Spreng.* S1 xS2/SH *DDS 1310*

Chelone glabra L. *DDS 3165*

Dasistoma macrophylla (Nutt.) Raf. *DDS 2701*

Gratiola neglecta Torr. *DDS 1835*

Linaria canadensis (L.) Dumont *DDS 1360*

Lindernia dubia (L.) Penn. *DDS 894*

L. monticola Muhl. *ex* Nutt.* xS3 *DDS 1878*

Mecardonia acuminata (Walt.) Small *DDS 2773*

Mimulus alatus Ait. *DDS 2333*

Paulownia tomentosa (Thunb.) Steud.† *DDS 1040*

Pedicularis canadensis L. *DDS 1314*

Penstemon calycosus Small *DDS 1833*

Scrophularia marilandica L. *Whetstone 15,7.*

Seymeria cassioides (C.F. Gmel.) Blake *DDS 3107*

Verbascum blattaria L.† *DDS 1736*

V. thapsus L.† *DDS 851*

Veronica arvensis L.† *DDS 1182*

V. peregrina L.† *DDS 3706*

SIMAROUBACEAE (Quassia Family)

Ailanthus altissima (Mill.) Swingle† *DDS 1070*

SOLANACEAE (Nightshade/Potato Family)

Datura stramonium L.† *DDS 2018*

Lycopersicon esculentum Mill.† *DDS 1895*

Physalis heterophylla Nees *DDS 5494*

P. pubescens L. *DDS 2542*

P. virginiana Mill. *DDS 849*

Solanum americanum Mill. [*S. ptycanthum*] *DDS 855*

S. carolinense L. *DDS 826*

STAPHYLEACEAE (Bladdernut Family)

Staphylea trifolia L. *DDS 1292*

STYRACACEAE (Storax Family)

Halesia tetraptera Ellis [*H. carolina*] *DDS 1331*

Styrax americana Lam. *DDS 1464*

S. grandifolia Ait. *DDS 5470*

SYMPLOCACEAE (Sweetleaf Family)

Symplocos tinctoria (L.) L'Her. *DDS 1052*

THEACEAE (Tea/Camellia Family)

Stewartia ovata (Cav.) Weatherby* S2S3 *Whetstone 15,285*

THYMELAEACEAE (Mezereum Family)

Dirca palustris L. *DDS 1139*

TILIACEAE (Linden Family)

Tilia americana L. [*T. heterophylla*] *DDS 1440*

ULMACEAE (Elm Family)

Celtis laevigata Willd. *DDS 2091*

C. tenuifolia Nutt. [*C. occidentalis* var. *georgiana*] *DDS 1065*

C. occidentalis L. *DDS 2329*

Ulmus alata Michx. *DDS 1162*

U. americana L. *DDS 2115*

U. rubra Muhl. *DDS 2334*

URTICACEAE (Nettle Family)

Boehmeria cylindrica (L.) Sw. *DDS 872*

Laportea canadensis (L.) Weddell *DDS 2719*

Parietaria pensylvanica Muhl. *ex* Willd. *DDS 2083*

Pilea pumila (L.) Gray *DDS 872*

VALERIANACEAE (Valerian Family)

Valerianella radiata (L.) Dufr. *DDS 1153*

VERBENACEAE (Verbena Family)

Callicarpa americana L. *DDS 874*

Phyla lanceolata (Michx.) Greene [*Lippia lanceolata*] *DDS 2319*

Verbena bonariensis L.† *DDS 2169*

V. brasiliensis Vell.† *DDS 1030*

V. simplex Lehm. *DDS 2355*

V. urticifolia L. *DDS 2156*

VIOLACEAE (Violet Family)

Hybanthus concolor (Forster) Spreng. *DDS 1480*

Viola hastata Michx. *DDS 3461*

V. hirsutula Brainerd *DDS 1114*

V. palmata L. [*V. palmata* var. *triloba*] *DDS 1256*

V. pedata L. *DDS 1300*

V. pubescens Ait. var. *eriocarpa* (Schw.) Russell [*V. eriocarpa*] *DDS 1328*

V. primulifolia L. [*V. bicolor*] *DDS 1713*

V. rafinesquei Greene *DDS 1109*

V. rostrata Pursh *DDS 1140*

V. sagittata Ait. var. *ovata* (Nutt.) T. & G. [*V. fimbriatula*] *DDS 1301*

V. sororia Willd. [*V. papilionacea*; *V. affinis*; *V. floridana*] *DDS 1141*

V. tripartita Ell. var. *tripartita* *DDS 3459*

V. tripartita var. *glaberrima* (DC.) Harper *DDS 1502*

VITACEAE (Grape Family)

Ampelopsis arborea (L.) Koehne *DDS 5467*

A. cordata Michx. *DDS 1818*

Parthenocissus quinquefolia (L.) Planchon *DDS 1631*

Vitis aestivalis Michx. *DDS 2327*

V. cinerea Engelm. *ex* Millard. var. *cinerea* *DDS 1497*

V. cinerea var. *baileyana* (Munson) Comeaux [*V. baileyana*] *DDS 4063*

V. riparia Michx. *DDS 4064*

V. rotundifolia Michx. *DDS 1598*

V. vulpina L. *DDS 3761*

CLASS LILIOPSIDA

AGAVACEAE (Century-Plant Family)

Manfreda virginica (L.) Salisb. [*Agave virginica*] *DDS 2152*

Yucca filamentosa L. *DDS 1146*

ALISMATACEAE (Water-plantain Family)

Alisma subcordatum Raf. *DDS 888*

Echinodorus cordifolius (L.) Griseb. *DDS 2525*

Sagittaria australis (J.G. Smith) Small [*S. longirostra*] *DDS 889*

AMARYLLIDACEAE [Liliaceae] (Amaryllis Family)

Hymenocallis occidentalis (Le Conte) Kunth *DDS 2596*

Hypoxis hirsuta (L.) Cov. *DDS 1311*

Narcissus poeticus L.† *DDS 1370*

N. pseudo-narcissus L.† *DDS 1152*

ARACEAE (Arum Family)

Arisaema dracontium (L.) Schott *DDS 2090*

A. triphyllum (L.) Schott [*A. quinatum*] *DDS 1257*

Peltandra virginica (L.) Schott *DDS 2121*

COMMELINACEAE (Spiderwort Family)

Commelina communis L.† *DDS 2315*

C. virginica L. *DDS 820*

Murdannia keisak (Hassk.) Hand-Mazz.† [*Aneilema keisak*] *DDS 871*

Tradescantia ohiensis Raf. *DDS 925*

T. subaspera Ker. *DDS 1659*

T. virginiana L. *DDS 1290*

CYPERACEAE (Sedge Family)

Bulbostylis capillaris (L.) Clarke *DDS 2599*

Carex abscondita Mack. *DDS 1636*

C. albolutescens Schw. *DDS 2378*

C. annectens Bickn. *DDS 1467*

C. artitecta Mack. *DDS 1091*

C. blanda Dewey *DDS 1965*

C. caroliniana Schw. *DDS 1428*

C. cephalophora Muhl. *ex* Schkuhr *DDS 1984*

C. cherokeensis Schw. *DDS 1521*

C. complanata Torr. & Hook. *DDS 1893*

C. crinita Lam. *DDS 1549*

C. debilis Michx. *DDS 1510*

C. digitalis Willd. *DDS 4067*

C. festucacea Schkuhr *DDS 1437*

C. frankii Kunth *DDS 1791*

C. glaucescens Ell. *DDS 2577*

C. gracilescens Steud. *DDS 3498*

C. granularis Muhl. *ex* Willd. *DDS 1492*

C. grayi Carey *DDS 1390*

C. intumescens Rudge *DDS 1992*

C. jamesii Schw. *DDS 1472*

C. joorii Bailey *DDS 2612*

C. leavenworthii Dewey *DDS 1418*

C. lupulina Muhl. *ex* Schkuhr *DDS 1827*

C. lurida Wahlenb. *DDS 1461*

C. nigromarginata Schw. *DDS 1752*

C. oligocarpa Schkuhr *DDS 1475*

C. oxylepis Torr. & Hook. *DDS 3489*

C. pensylvanica Lam. *DDS 2065*

C. physorhyncha Liebm. *DDS 3722*

C. picta Steud. *DDS 1145*

C. plantaginea Lam. *DDS 7384*

C. retroflexa Muhl. *ex* Schkuhr *DDS 1374*

C. rosea Schkuhr *DDS 1436*

C. striatula Michx. *DDS 1860*

C. styloflexa Buckl. *DDS 1321*

C. tribuloides Wahlenb. *DDS 1848*

C. virescens Muhl. *ex* Schkuhr *DDS 4065*

C. vulpinoidea Michx. *DDS 1373*

C. willdenowii Schkuhr *DDS 1983*

Cyperus aristatus Rottb. [*C. inflexus; C. squarrosus*] *DDS 2597*

C. brevifolius (Rottb.) Endl. *ex* Hassk. [*Kyllinga brevifolia*] *DDS 3079*

C. difformis L.† *DDS 3268*

C. dipsaciformis Fern. *DDS 2276*

C. erythrorhizos Muhl. *DDS 816*

C. esculentus L. *DDS 2606*

C. filiculmis Vahl *DDS 2536*

C. globulosus Aublet [*C. croceus*] *DDS 2440*

C. iria L.† *DDS 2422*

C. odoratus L. *DDS 2541*

C. ovularis (Michx.) Torr. [*C. echinatus*] *DDS 841*

C. polystachyos Rottb. *DDS 3191*

C. retrorsus Chapm. *DDS 2697*

C. strigosus L. *DDS 818*

C. tenuifolius (Steud.) Dandy [*Kyllinga pumila*] *DDS 2529*

Eleocharis acicularis (L.) R. & S. *DDS 2578*

E. obtusa (Willd.) Schult. *DDS 1457*

Fimbristylis autumnalis (L.) R. & S. *DDS 3161*

Rhynchospora chalarocephala Fern. & Gale *DDS 4324a*

R. corniculata (Lam.) Gray *DDS 2466*

R. globularis (Chapm.) Small *DDS 1987*

R. glomerata (L.) Vahl *DDS 7383*

R. inundata (Oakes) Fern. *DDS 2534*

Scirpus americanus Pers. [*S. olneyi*] *DDS 2131*

S. atrovirens Willd. *DDS 1692*

S. cyperinus (L.) Kunth *DDS 884*

S. purshianus Fern.* *xS1 DDS 7375*

S. validus Vahl *DDS 2123*

Scleria oligantha Michx. *DDS 1776a*

DIOSCOREACEAE (Yam Family)

Dioscorea batatas Dcne.† *DDS 905*

D. villosa L. *DDS 1572*

HYDROCHARITACEAE (Tape-grass Family)

Egeria densa Planch.† [*Elodea densa*] *Reported by Linda Reynolds*

Elodea canadensis Michx.* S1 *DDS 2060*

Hydrilla verticillata (L. *f.*) Casp.† *DDS 4492*

IRIDACEAE (Iris Family)

Iris cristata Ait. *DDS 3463*

I. verna L. *DDS 1315a*

Sisyrinchium angustifolium Mill. *DDS 1430*

S. atlanticum Bickn. [*S. mucronatum* var. *atlanticum*] *DDS 1334*

JUNCACEAE (Rush Family)

Juncus acuminatus Michx. *DDS 1837*

J. biflorus Ell. *DDS 2348*

J. coriaceus Mack. *DDS 2094*

J. dichotomus Ell. *DDS 1877*

J. diffusissimus Buckl. *DDS 2110*

J. effusus L. *DDS 1469*

J. longii Fern. *DDS 2001*

J. marginatus Rostk. *DDS 3162*

J. repens Michx. *DDS 4452*

J. scirpoides Lam. *DDS 2144*

J. secundus Beauv. *ex* Poir. *DDS 2184*

J. tenuis Willd. *DDS 1569*

J. validus Cov *DDS 2398*

Luzula acuminata Raf. *DDS 1330*

L. echinata (Small) Herm. *DDS 1117*

LEMNACEAE (Duckweed Family)

Lemna valdiviana Phil. *DDS 4336*

Spirodela polyrrhiza (L.) Schleid. *DDS 2114*

Wolffia columbiana Karsten *DDS 6805*

LILIACEAE (Lily Family)

Allium canadense L. *DDS 1365*

A. speculae Owenb. & Aase* S2 *xS1/C2 DDS 1579*

A. vineale L.† *DDS 2004*

Amianthium muscaetoxicum (Nutt.) Gray
Reported by Linda Reynolds

Camassia scilloides (Raf.) Cory *DDS 1394*

Chamaelirium luteum (L.) Gray *DDS 1679*

Disporum lanuginosum (Michx.) Nichols. *DDS 2725*

Erythronium americanum Ker
ssp. *harperi* (Wolf) Parks & Hardin *DDS 1147*

E. umbilicatum Parks & Hardin* S1 *DDS 1313*

Hemerocallis fulva L.† *DDS 2011*

Lilium michauxii Poir. *DDS 2669*

Medeola virginiana L. *DDS 5449*

Muscari racemosum (L.) Mill.† *DDS 1271*

Nothoscordum bivalve (L.) Britt. [*Allium bivalve*]
DDS 1134

Polygonatum biflorum (Walt.) Ell. *DDS 924*

P. pubescens (Willd.) Pursh* [S?] *DDS 1447*

Schoenolirion wrightii Sherman* S? *xS2/3C*
DDS 1586

Smilacina racemosa (L.) Desf. *DDS 1295*

Trillium cuneatum Raf. *DDS 1113*

T. stamineum Harb. *DDS 3446*

T. sulcatum Patrick* S1 *DDS 1674*

Uvularia grandiflora Smith,* *xS? DDS 1327*

U. perfoliata L. *DDS 1241*

U. sessilifolia L. *DDS 1718*

Veratrum parviflorum Michx.* *xS1S2 DDS 4175*

NAJADACEAE (Water-nymph Family)

Najas guadalupensis (Spreng.) Magnus *DDS 2474*

N. minor All.† *DDS 2062*

ORCHIDACEAE (Orchid Family)

Corallorhiza wisteriana Conrad* S2 *DDS 9757*

Cypripedium calceolus L.
var. *pubescens* (Willd.) Correll* *xS3 DDS 5474*

Goodyera pubescens (Willd.) R. Br. *DDS 5460*

Spiranthes ovalis Lindl. *DDS 3280*

S. tuberosa Raf. [*S. grayi*] *DDS 2785*

S. vernalis Engelm. & Gray *DDS 2137*

Tipularia discolor (Pursh) Nutt. *DDS 1093*

Triphora trianthophora (Sw.) Rydb.
Reported by L. Reynolds

POACEAE (Grass Family)

Agrostis canina L.† *DDS 2293*

A. elliottiana Schult. *DDS 2660*

A. hiemalis (Walt.) BSP *DDS 1560*

A. perennans (Walt.) Tuckerm. *DDS 2768*

Aira caryophyllea L.† *DDS 1776*

A. elegans Willd. *ex* Gaudin *DDS 3774*

Alopecurus carolinianus Walt. *DDS 3708*

Andropogon glomeratus (Walt.) BSP *DDS 6796*

A. ternarius Michx. *DDS 978*

A. virginicus L. *DDS 994*

Aristida dichotoma Michx. *DDS 3106*

A. longespica Poir. *DDS 3281*

A. oligantha Michx. *DDS 6797*

A. purpurascens Poir. *DDS 3155*

Arthraxon hispidus (Thunb.) Mak. *DDS 3128*

Arundinaria gigantea (Walt.) Muhl. *DDS 1055*

Avena sativa L.† *DDS 2009*

Brachyelytrum erectum (Schreb.) Beauv. *DDS 2103*

Bromus catharticus Vahl† *DDS 1564*

B. commutatus Schrad.† *DDS 1567*

B. hordeaceus L.† [*B. mollis*] *DDS 1956*

B. japonicus Thunb.† *DDS 1793*

B. pubescens Muhl. *ex* Willd. [*B. purgans*] *DDS 1499*

B. tectorum L.† *DDS 1352*

Chasmanthium latifolium (Michx.) Yates [*Uniola latifolia*] *DDS 919*

C. laxum (L.) Yates [*Uniola laxa*] *DDS 2579*

C. sessiliflorum (Poir.) Yates [*Uniola sessiliflora*] *DDS 1064*

Cinna arundinacea L. *DDS 3073*

Cynodon dactylon (L.) Pers..† *DDS 1863*

Dactylis glomerata L.† *DDS 1388*

Danthonia sericea Nutt. *DDS 1581*

D. spicata (L.) Beauv. *ex* R. & S. *DDS 1557*

Deschampsia flexuosa (L.) Trin. *DDS 1985*

Dichanthelium acuminatum (Sw.) G. & C. [*Panicum lanuginosum*] *DDS 1737*

D. boscii (Poir.) Gould [*Panicum boscii*] *DDS 1405*

D. clandestinum (L.) Gould [*Panicum clandestinum*] *DDS 1697*

D. commutatum (Schult.) Gould [*Panicum commutatum*] *DDS 1399*

D. dichotomum (L.) Gould [*Panicum dichotomum*] *DDS 1689*

D. laxiflorum (Lam.) Gould [*Panicum laxiflorum*] *DDS 1378*

D. ravenelii (Scribn. & Merr.) Gould [*Panicum ravenelii*] *DDS 1954*

D. scoparium (Lam.) Gould [*Panicum scoparium*] *DDS 2284*

D. sphaerocarpon (Ell.) Gould var. *sphaerocarpon* [*Panicum sphaerocarpon*] *DDS 1986*

D. sphaerocarpon var. *isophyllum* (Scribn.) G. & C. [*Panicum polyanthes*] *DDS 2180*

Digitaria ciliaris (Retz.) Koel. *DDS 3130*

D. ischaemum (Schreb.) Schreb. *ex* Muhl.† *DDS 827*

Echinochloa crus-galli (L.) Beauv.† *DDS 997*

Eleusine indica (L.) Gaertn.† *DDS 950*

Elymus virginicus L. *DDS 2002*

Eragrostis capillaris (L.) Nees *DDS 3154*

E. cilianensis (All.) Lutati† *DDS 2447*

E. curvula (Schrad.) Nees† *DDS 1851*

E. hirsuta (Michx.) Nees *DDS 834*

E. minor Host† [*E. poaeoides*] *DDS 6798*

E. pectinacea (Michx.) Nees *DDS 2654*

E. pilosa (L.) Beauv.† *DDS 7339*

E. spectabilis (Pursh) Steud., PURPLE LOVEGRASS. *DDS 2552*

Eremochloa ophiuroides (Munro) Mack.† *Reported by Linda Reynolds*

Erianthus alopecuroides (L.) Ell. *DDS 982*

E. contortus Baldw. *ex* Ell. *DDS 933*

E. giganteus (Walt.) Muhl. *DDS 2640*

Festuca elatior L.† [*F. pratensis*] *DDS 1364*

F. obtusa Biehler *DDS 1515*

Glyceria striata (Lam.) Hitchc. *DDS 1625*

Gymnopogon ambiguus (Michx.) BSP *DDS 6802*

Hordeum pusillum Nutt. *DDS 1348*

Hystrix patula Moench [*Elymus histrix*] *DDS 2008*

Imperata brasiliensis Trin.† *DDS 1006*

Leersia oryzoides (L.) Sw. *DDS 893*

L. virginica Willd. *DDS 914*

Lolium multiflorum Lam† *DDS 1570*

L. perenne L.† *DDS 1865*

Melica mutica Walt.GRASS. *DDS 1320*

Microstegium vimineum (Trin.) A. Camus† [*Eulalia vimínea*] *DDS 3131*

Muhlenbergia schreberi J.F. Gmel. *DDS 3133*

M. sobolifera (Muhl.) Trin.* SI *Whetstone 15,729*

Panicum anceps Michx. *DDS 2451*

P. capillare L. *DDS 2647*

P. dichotomiflorum Michx. *DDS 847*

P. philadelphicum Bernh. *DDS 2770*

P. rigidulum Nees [*P. agrostoides*] *DDS 904*

P. virgatum L. *DDS 2591*

Paspalum boscianum Flugge *DDS 3273*

P. dilatatum Poir.† *DDS 811*

P laeve Michx. *DDS 3265*

P. lividum Trin. *ex* Schlechtend. *DDS 3158*

P. notatum Flugge var. saurae Parodi† *DDS 825*

P. pubiflorum Rupr. *DDS 2650*

P. urvillei Steud. *DDS 2127*

Phleum pratense L.† *DDS 2015*

Poa annua L.† *DDS 1167*

P. autumnalis Muhl. *ex* Ell. *DDS 1431*

P. chapmaniana Scribn. *DDS 1379*

P cuspidata Nutt. *DDS 1128*

P. pratensis L.† *DDS 1353*

P sylvestris Gray *DDS 1395*

Schizachyrium scoparium (Michx.) Nash [*Andropogon scoparius*] *DDS 3104*

Setaria faberi W Herrman† *DDS 2298*

S. geniculata (Lam.) Beauv. *DDS 2168*

S. glauca (L.) Beauv.† *DDS 858*

S. viridis (L.) Beauv † *DDS 2441*

Sorghastrum elliottii (Mohr) Nash *DDS 3157*

S. nutans (L.) Nash *DDS 6787*

Sorghum halepense (L.) Pers.† *DDS 864*

Sphenopholis nitida (Biehler) Scribn. *DDS 1401*

S. obtusata (Michx.) Scribn. *DDS 1545*

Sporobolus indicus (L.) R. Br.† [*S. poiretii*] *Reported by Mark Ballard*

Stipa avenacea L. [*Piptochaetium avenacea*] *DDS 1406*

Tridens flavus (L.) Hitchc. *DDS 865*

Tripsacum dactyloides L. *DDS 842*

Triticum aestivum L.† *DDS 1734*

Vulpia myuros (L.) K. C. Gmel.† [*Festuca myuros*] *DDS 1559*

V. octoflora (Walt.) Rydb. [*Festuca octoflora*] *DDS 1562*

Zizaniopsis miliacea (Michx.) Doell & Asch.,. *DDS 2049*

PONTEDERIACEAE (Water-Hyacinth Family)

Heteranthera reniformis R. & P *DDS 870*

POTAMOGETONACEAE (Pondweed Family)

Potamogeton crispus L.† *DDS 2058*

P. diversifolius Raf. *DDS 4494*

P. nodosus Poir. *DDS 945*

P. pusillus L. *DDS 2061*

SMILACACEAE [Liliaceae] (Greeenbrier Family)

Smilax bona-nox L. *DDS 2361*

S. glauca Walt. *DDS 1730*

S. herbacea L. *DDS 3702*

S. hugeri (Small) J.B.S. Norton *ex* Penn.

[*S. ecirrhata* var. *hugeri*] *DDS 3514*

S. pulverulenta Michx..

[*S. herbacea* var. *pulverulenta*] *DDS 3760*

S. rotundifolia L. *DDS 1479*

S. tamnoides L. [*S. hispida*] *DDS 2723*

STEMONACEAE (Stemona Family)

Croomia pauciflora (Nutt.) Torr.* S2 *xS3*

Reported by Linda Reynolds

TYPHACEAE (Cat-tail Family)

Typha latifolia L. *DDS 932*

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LITERATURE CITED

Alabama Natural Heritage Program [ANHP]. 1994. Vascular Plant Inventory Tracking List, April edition. Montgomery, Alabama.

Alabama Natural Heritage Program [ANHP]. 1996 Species Inventory List. Montgomery, Alabama

Bailey, L.H. and E.Z. Bailey. 1976. Hortus Third, a concise dictionary of plants cultivated in the United States and Canada. Revised and expanded by the staff o the L.H. Bailey Hortorium. MacMillan Publishing Co., New York.

Cronquist, A. 1980. Vascular Flora of the Southeastern United States, Vol. I. Asteraceae. The University of North Carolina Press, Chapel Hill, North Carolina.

Fernald, M.L. 1950. Gray's Manual of Botany. 8th edition. American Book Company, New York.

Flora of North America [FNA] Editorial Committee, eds. 1993+. Flora of North America North of Mexico. 3+ vols., New York and Oxford.

Freeman, J.E., A.S. Causey, J.W. Short and R.R. Haynes. 1979. Endangered, threatened, and special concern plants of Alabama. Department of Botany and Microbiology, Agricultural Experiment Station, Departmental Series No. 3, Auburn University, Auburn, Alabama.

Isley, D. 1990. Vascular flora of the Southeastern United States, Vol. III., Part 2. Leguminosae (Fabaceae). The University of North Carolina Press, Chapel Hill, North Carolina.

Luer, C.A. 1975. The Native Orchids of the United States and Canada excluding Florida. New York Botanical Garden, W.S.Cowell, Ltd., Ipswich, England.

Muenscher, W.C. 1955. Weeds, 2nd edition. Reissued 1980 with a new foreword and appendixes. Cornell University Press, Ithaca, New York.

Radford, A.E., H.E. Ahles and C.R. Bell. 1968. Manual of the Vascular Flora of the Carolinas. The University of North Carolina Press, Chapel Hill, North Carolina.

Spaulding, D.D. 1995. The vascular flora of Lake Guntersville State Park, Marshall County, Alabama. M.S. Thesis, Department of Biology, Jacksonville State University, Jacksonville, Alabama.

Wunderlin, R.P. 1982. Guide to the Vascular Plants of Central Florida. University of South Florida Press/University Presses of Florida, Gainesville.

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BOOK REVIEWS

Beginning with this issue, the *Journal* will publish reviews of recently published books. Manuscripts are solicited from the Academy membership in quantities sufficient to support the inclusion of one or more reviews in each issue. Contributions representing all sections of the Academy are desired, and the intent is that these contain more detail than the short, uncritical summaries often offered as book reviews by many professional science journals today. Submission of comprehensive reviews is welcomed, although shorter but substantial reviews are also solicited. Reviews representing the range of depth and detail sought for future reviews are published in the present isssue.

The aim of a review is to inform the reader about characteristics of the book, identify outstanding features or shortcomings that may be present, offer a critical appraisal of the book's contents, and when appropriate, offer information that might enable further editions of the work to be improved. Some reviews in this series may seem harsh or negative, but in most cases this will be an artifact resulting from the fact that helpful reviews offer thoughtful, constructive criticism rather than heaping endless praise on the meritorious. For those whose books are criticized, it is important to realize that only books of significance are reviewed here.

-The Editor

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SEARCHING FOR A PEACE BETWEEN SCIENCE AND RELIGION

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The Sacred Depths of Nature by Ursula Goodenough. 197 pp. New York: Oxford University Press, 1998. $24.00

Rocks of Ages--Science and Religion in the Fullness of Life by Stephen J. Gould. 241 pp. New York: The Ballantine Publishing Group, 1999. $18.95

People with science-based, yet restless, minds for whom it is a conundrum to arrive at a satisfying relationship between the rational objectivity of science and the nonrational religious yearnings of the heart were offered two new books on this subject by scientists during the past two years. In these works Ursula Goodenough and Stephen J. Gould describe what they believe to be the proper relationship between science and religion. Both authors are biologists, but they disagree on this subject. The pair of books offers a richness of ideas for thoughtful readers striving to contain both "ways of knowing" within a single mind.

Not long before encountering these books I read an essay by Ian Barbour (Carlton College, MN, and 1999 winner of the Templeton Prize for Progress in Religion) in which he describes a framework for comparing diverse views that scientists, philosophers and theologians have taken on the relationship between science and religion. In "Surveying the Possibilities" (In *Religion and the Natural Sciences*, J.E. Huchingson, ed., Harcourt Brace, 1993), Barbour describes the arguments of more than a score of thinkers on this subject and assigns the view of each to one of four categories: *Conflict*, *Independence*, *Dialogue*, and *Integration*.

Conflict is epitomized by the positions of religious fundamentalists and scientific materialists. The former use inerrant, revealed knowledge to construct a foundation from which they have a penchant for making pronouncements on scientific matters. The latter are based in the methods of science, but sometimes make broad philosophical claims with theological implications. Neither group recognizes boundaries that may limit the knowing-power of its particular domain of human knowledge.

Independence describes science and religion as autonomous, independent enterprises, each with its own language, methods and functions. In the relationship of *independence*, each enterprise limits itself to its own methods, recognizes its limitations, and respects its own boundaries. Boundary definitions are critical since any areas of overlap may jeopardize the

independence of both domains.

Dialogue recognizes that even though the methods and content of science and religion differ, there exist points of contact between them where "boundary questions" are raised. For example, science relies on the intelligibility of Nature for legitimation of its methods. Many scientists therefore consider it appropriate for science to ask about the source of this intelligibility. Most theologians, on the other hand, view such questions of ultimacy as religious questions unanswerable by science. Arguing that science and theology at times display methodological similarities, Barbour suggests that "if theology at its best is a reflective enterprise that can develop and grow, it can be open to new insights, including those derived from the theories of science." Thus, boundary questions and parallel methodologies can encourage dialogue between science and religion.

Integration of the content of science and theology occurs within views such as (1) *natural theology* that argues for God's existence from design in nature, (2) a *theology of nature* in which certain theological doctrines are reformulated in light of scientific discovery, and (3) a *systematic synthesis* in which "both science and religion contribute to a coherent world view elaborated in a comprehensive metaphysics." *Process philosophy*, whose practitioners view God as the ultimate source of order in Nature which itself is viewed as incomplete and still coming into being, is offered as an example of a systematic synthesis.

Do the books reviewed here espouse opinions that comfortably occupy positions within the four-part framework constructed by Barbour?

Ursula Goodenough (Washington University, MO) is a cell biologist recognized internationally for her contributions to our understanding of the underlying cellular and genetic mechanisms responsible for the evolution of sex, i.e. the recombination of parental genetic material that produces offspring different from the parents for the next generation. She is a past President of the American Society for Cell Biology, past President of the Institute for Religion in an Age of Science, and co-author of a widely used college textbook on genetics. *The Sacred Depths of Nature* is her first book for the general public, a book intimately personal in its description of how one scientist has integrated a modern, scientific understanding of nature with a deep sense of religious awe and wonder which has been with her since childhood.

Goodenough credits the influence of her father, first a Methodist minister and later a Professor of the History of Religion at Yale University, as providing the inspiration that led to the writing of *The Sacred Depths of Nature*. In the *Personal* section that begins the book she shares other information about family and upbringing that helps to illuminate what follows. The ultimate aim of the book is to lay the groundwork for a set of global ethics; and critical to this project is understanding that all major systems of religious thought answer two questions: "What is?" and "What matters?" The first question is answered by a religion's *Cosmology* and the second by its *Ethos*. Cosmologies explain the origin of the world and life within it. The Ethos or Morality emerging from a given Cosmology tells how we should behave toward Nature and toward each other.

Unfortunately for planet Earth and for ourselves, theological cosmologies and their emergent moralities differ so as to produce conflict that results in evils such as warfare, plundering of the natural environment, and irreversible destruction of the biosphere. If one

accepts the argument that religious differences are the underlying causes of our human and environmental crises, subscribes to a bipartite Cosmology/Ethos definition of religion, and agrees with Goodenough that a religion's Ethos emerges from its Cosmology and not vice versa or some other way, then her reasoned solution to humanity's ills is at first convincing: there is no longer a rational reason for the existence of more than one Cosmology since we now have one that "happens to be true" - the Cosmology offered by science! Education thus becomes a route to salvation for ourselves and the planet. Once everybody (or nearly so) understands the truth of the scientific cosmology i.e. the Big Bang, the origin of stars and planets via the natural laws of physics, the origin of life from natural laws of chemistry, and the origin of biodiversity and humanity via evolution by natural selection, we are halfway toward establishing a global, planet-saving theology. Realization of a worldwide Ethos emerging from that Cosmology will take us the rest of the way. Goodenough maintains or perhaps, in quiet honest moments of reflection, *hopes* that a common Ethos will emerge naturally among all peoples of all cultures once they understand the scientific explanation for the origin of things. This global Ethos will have three components, (1) *gratitude* that we exist at all, (2) *reverence* for how life works, and (3) an *imperative* that life continues.

Goodenough wastes no time before embarking upon the project of educating her readers to the scientific cosmology. She moves through short, poetically written chapters with titles that could be used for a textbook in general biology: Origins of the Earth, Origins of Life, How an Organism Works, How Evolution Works, The Evolution of Biodiversity, Sex, Multicellularity and Death, Speciation... These stories are told in the spirit of Brian Swimme's and Thomas Berry's *The Universe Story* but mercifully without their unprofessional anthropomorphizing of Nature. Each chapter begins with an accurate, nontechnical description of science's present understanding of the subject which, with concentration, a high school graduate with a B grade GPA should be able to comprehend. At the end of each chapter she offers "Reflections" on the subject - religious feelings that are conjured up by understanding. Her "Reflections" celebrate the Mystery that still resides within what she knows to be true. Expressions of that Mystery range from her personal reflections to stanzas from Methodist and Presbyterian hymns, poetry by Michelangelo, Walt Whitman, and Daniel Iverson, a Pawnee prayer, and lines from the Tao Te Ching. The sense is that one need not be a theist in order to experience these religious feelings, and Goodenough confirms that about herself for us midway through the book.

Goodenough sees the foundation she is laying for a new planetary ethic as coexisting with existing traditions, not supplanting them. My 22 year old daughter is a recent graduate in cultural anthropology from the University of Washington. During my visit with her last fall in Seattle, we took a Sunday afternoon ferry to Bainbridge Island. In Winslow was a wonderful Coffee Shoppe where we savored double cappucini and *pasta dolce*. Buoyed by the caffeine, we strolled the empty, early evening streets philosophizing about the meaning of the cosmos and our existence in it. Fresh off my first reading of *The Sacred Depths of Nature*, I offered Goodenough's thesis to our conversation - how with humanity's eventual education on the one true Cosmology, a cross-cultural, global Ethos of gratitude, reverence, and conservation will emerge, and the planet will be saved, we along with it. Sara watched me across her shoulder until I finished and then quietly responded, "What about cultural

relativity?" With this she of course nailed a major problem with Goodenough's proposed route to establishing a global Ethos. Assuming that all of humanity could one day hear about and comprehend the scientific cosmology without damage being done to their existing religious traditions, how are we to believe that all people from all cultures and economic strata will feel an awe and wonder over the mystery of existence similar to that felt by Goodenough (and perhaps by ourselves) and will then recognize that the appropriate responses to such feelings are *gratitude*, *reverence*, and a conservation *imperative* for ensuring that Life continues?

Were it not that Barbour's **Integration** relationship for science and religion supposes that the religious side of the association is theistic, Goodenough's vision for a planetary Cosmology and Ethos would land neatly into that category. Her views certainly do not foster **Conflict** or suggest **Independence**; and what she reveals to us about her personal relationship with science and religion shows that much more is going on than **Dialogue** over some boundary questions. Goodenough's views do not fit into any of these categories. What she recommends is not integration between science and a belief in the supernatural but rather a healthy cohabitation of the rationality of our cerebral cortex and the sense of mystery and wonder that emanates from our limbic system - what I would call a **Biology-Based Integration**.

It would be nice to believe that Ursula Goodenough's global education/emergent Ethos project will be realized, but neither the objectiveness of rationality nor her book gives me reason to be very hopeful that it is within humanity's grasp. Educating everybody to the fact that all of the atoms in all of the molecules in all plant and animal tissues including our own were forged inside a star before the planet Earth existed is a noble goal that could help humans to appreciate their place within Nature, but it is also fraught with obvious, practical difficulties. Yet, I am an optimist. Surely, working to increase the percentage of the earth's population that can witness the Milky Way on a clear, dark night or discover wild flowers blooming on the forest floor in springtime is something that privileged citizens of the West can do that would be beneficial for everyone.

Stephen J. Gould, author of more than 15 books and monthly essayist for *Natural History* magazine, is arguably the most prolific author on science for nonscientists in the 20th century. He is Alexander Agassiz Professor of Zoology, Professor of Geology, and Curator for Invertebrate Paleontology at Harvard University. Gould and his collaborator, Niles Eldredge, are widely credited for introducing in the 1970s the concept of punctuated equilibrium into the dialogue concerned with understanding the paleontological record in the context of known mechanisms for speciation.

Rocks of Ages is an expansion of ideas presented in a March, 1997, essay for *Natural History* titled "Nonoverlapping Magisteria". A magisterium (from the Latin *magister*, or teacher) "represents a domain of authority in teaching...a domain where one form of teaching holds the appropriate tools for meaningful discourse and resolution". Thus, the magisterium of science deals empirically with the substance and workings of the universe, while religion covers questions of moral value and ultimate meaning. Gould uses the acronym NOMA (NonOverlapping MAgisteria) to describe the relationship between science and religion. These are humankind's "two rocks of ages" which Gould says that he and "nearly all people

of goodwill (wish to see)...coexisting in peace while each works to make a distinctive patch for the integrated coat of many colors that will celebrate the distinctions of our lives, yet cloak human nakedness in a seamless covering called wisdom."

The stated purpose of an early section (and my favorite section) of the book titled "A Tale of Two Thomases" is to sharpen the distinction between the two magisteria. The first Thomas is Jesus' disciple who, operating within the magisterium of religion, displays the inquiring mind of a practitioner of modern science. When Jesus tells the disciples at the Last Supper, "Trust in God always; trust also in me. There are many dwelling-places in my Father's house...I am going there on purpose to prepare a place for you." Thomas replies, "Lord, we do not know where you are going, so how can we know the way?" After the crucifixion when the other disciples tell Thomas that they have seen the risen Jesus, Thomas earns his reputation as a skeptic with the words, "Unless I see the mark of the nails on his hands, unless I put my finger into the place where the nails were, and my hand into his side, I will not believe it." Later Thomas is given this opportunity and then skillfully taught by Jesus about the proper mode of behavior within the magisterium of religion: "Because you have seen me you have found faith. Happy are they who never saw me and yet have found faith." Gould observes for us that the actions of Doubting Thomas would have been admirable within the magisterium of science but properly earned him a gentle scolding from his mentor within the magisterium of faith.

The second Thomas is The Reverend Thomas Burnet (1635-1715), scientist author of *The Sacred Theory of the Earth*, criticism of which, according to Gould, helped to inspire mid-18th century foundational studies for historical anthropology by Gembattista Vico and seminal work in natural history by Georges Buffon. Burnett's book contains sections on the biblical Great Flood, the paradise preceding it, the upcoming conflagration of the world, and the paradise to be regained after the second destruction of the world. He accepts biblical scripture as generally true but not literally so, and operates within his century's religious belief that God allows no contradiction between his *words* in scripture and his *works* in Nature. Since words are open to diverse interpretations but Nature operates according to invariant laws, a correct reading of the Book of Nature was thought to be able to inform one's interpretation of the Book of Scripture.

Estimating that all of the water in the earth's oceans would not be sufficient to produce the universal deluge, Burnett hypothesizes that the original earth's smooth crust covered a layer of water sufficient to do the job and that in Noah's time, cracks in the crust allowed the water to leak through to flood the earth and reshape its topography. Gould commends Burnett, a clergyman, for upholding the primacy of science in understanding the natural world and thereby respecting the NOMA concept. We are reminded of the NOMA premise here and in several other places as the book progresses: "NOMA is a simple, humane, rational, and altogether conventional argument for mutual respect, based on non-overlapping subject matter, between two components of wisdom in a full human life: our drive to understand the factual character of nature (the magisterium of science), and our need to define meaning in our lives and a moral basis for our actions (the magisterium of religion)."

"A Tale of Two Thomases" is very interesting in an historical sense but not especially

useful for sharpening distinctions between the two magisteria; after all, Thomas the Disciple was operating before the notion of modern science, and Thomas Burnett, not unlike the Young Earth Creationist (YEC, pronounced "yech!"; my use of the acronym, not Gould's) of today, was clearly using scriptural truth, literal or not, to inform his hypotheses about the natural world.

What Gould means by NOMA does become clearer as the book progresses though, through numerous, fun-to-read historical snippets about men (only men, no women) who either succeeded or failed to practice NOMA in their professional and/or personal lives. Successful practitioners of NOMA include Pope John Paul II, Charles Darwin, Thomas Huxley, Aristotle and Judge Overton of Little Rock, Arkansas, and those less successful at this include Pope Pius XII, YECs and other fundamentalist protestants, Adolf Hitler, George William Hunter (author of *A Civic Biology*, the textbook from which John Scopes taught evolution), proponents of the Anthropic Principle like John Polkinghorne, the J. M. Templeton Foundation, and scientists who claim that science proves that life has no ultimate purpose.

Rocks of Ages is a treasure of uncommonly known information about commonly known events having varying relevance to the science-religion dialogue. For example, how many biologists know that William Jennings Bryan, who transformed himself into a buffoon with the help of Clarence Darrow and H.L. Mencken via the Scopes "Monkey Trial", had previously been one of the country's most courageous progressives: working for women's suffrage and for Philippine independence against American imperialism, making public his pacifist ideals during World War I, arguing for the direct election of senators, and promoting a graduated income tax? And who among us knew that the students in Scope's Tennessee classes reading Hunter's *A Civic Biology* learned, in addition to Darwinian evolution, that science supports what we now recognize to be racism and inexcusable social prejudice? For this kind of information alone, invaluable in the undergraduate classroom or in coffee house conversation, *Rocks of Ages* is well worth the read.

In a Platonic world, NOMA sounds like a good idea. Each example cited by Gould of the trouble caused when practitioners of either magisterium fail to practice NOMA seems convincing and tempted me into feeling that NOMA should be required doctrine for every person practicing science and/or religion. Somewhere in the midst of the final third of the book things began to feel uncomfortable. What had at first seemed like a water-tight case for NOMA started springing leaks in the form of unaddressed questions. How can a Maginot line be drawn between science and moral issues without at least a passing acknowledgment of the decades old discipline of sociobiology that argues for natural selection having played a role in shaping human ethics and values? What exactly does Gould envision by "jaw-jaw" and "the right amount of dialogue between devotees of disparate subjects" under the banner of NOMA which "urges (the) two distinct sides to stay on their own turf" and requires that the boundaries between them be nonoverlapping. If we faithfully practice NOMA, what do the two sides have to talk about?

Finally, Gould has defined and discussed religion too narrowly. His definition includes no cosmological component. Is this omission deliberate because Gould realizes that cosmologies are testable by science and that such testing would jeopardize the sanctity of

magisterium boundaries? His discussion of religion is limited to Roman Catholicism and Fundamentalist Protestantism, and examples of science are restricted mainly to evolution. What of the biology of pluripotent stem cells or of clones produced by somatic cell nuclear transfer and its significance for moral issues such conflict between the fundamental liberty of "bearing and begetting" children and the sanctity of individuality? These are areas where the two magisteria not only overlap but overlap differently depending on the religion-based moral system from which the issues are considered? If Muslims and Roman Catholics know that the inner cell mass of a human blastocyst harbors a soul, and if I as a cell biologist Know that really it is nothing more than a group of cells containing pluripotent genetic information that can give rise to all tissue and organ types in the body, what amount of dialogue will resolve our differences? Legislation reflecting "the will of the people" and not dialogue between dogmatists is what is needed to give medical technologists permission to disrupt this mass of cells in order to grow a kidney or liver needed for a life-saving transplant. When this is done, as it surely will be, there will be conflict between science and some religions, and no amount of practicing NOMA will resolve it.

With NOMA Gould argues for *independence* between the magisteria of science and religion. He asks us to accept that human ethics and morality are territories lying solely within the magisterium of religion. In so doing, he ignores recent books by two of his colleagues at Harvard University, Ernst Mayr (*This is Biology: The Science of the Living World*, Belknap Press) and Edward O. Wilson (*Consilience: The Unity of Knowledge*, Alfred A. Knopf), in which the plausible evolutionary bases for human morality are nicely discussed. The domains of science and religion possess legitimately overlapping regions and each magisterium must acknowledge that its turf within these territories is defined by organic fences with many open gates rather than by walls to be defended or even by boundaries to be respected.

The value and strengths of these two books are in areas other than their theses. *The Sacred Depths of Nature* is a fast read, a good place to learn about modern science's view on cosmology, planetology, and biology, and can help science-oriented people accept and even celebrate the religious feelings that they sometimes experience. The book also reminds us in beautiful ways about the benefits of showing and teaching children and students about nature. *Rocks of Ages* is fun and informative for its history and may help to diminish nonproductive conflict between the *overlapping* magisteria of science and religion.

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CONSILIENCE

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Consilience: the unity of knowledge by Edward O. Wilson. 332 pp. New York Alfred A Knopf, 1998. $26.00

Edward O. Wilson sets forth the need, indeed urgency, for a unification of learning/knowledge (i.e. consilience) among disciplines, which he identifies as occurring when "their modes of causal explanation are made consistent." He evaluates the natural sciences, the social sciences, the arts, and ethics and religion on the basis of their contributions to human knowledge as well as their failures to achieve that which each discipline sets out to do. He argues that, of all the disciplines, the natural sciences have been the most successful at adding to the body of knowledge which they have committed to explore (the material world) and that the reason other disciplines have not kept pace is that, unlike the natural sciences, they lack "a solid foundation of units and processes." He concludes that knowledge in other disciplines would increase/benefit by reaching consilience with the natural sciences (i.e. by adopting such a foundation and by making their modes of causal explanation consistent). Throughout the book Wilson comments that solving current problems requires an interdisciplinary approach to, and consilience with, the natural sciences. For example, he contends that the "current status of the social sciences can be put in perspective by comparing them with the medical sciences. Both have been entrusted with big, urgent problems."

Wilson observes that medical scientists are challenged with issues such as curing cancer and correcting genetic birth defects, while we expect social scientists "to tell us how to moderate ethnic conflict, convert developing countries into prosperous democracies, and optimize world trade." He contends that "medical sciences are...progressing dramatically," and that the scientists involved are connected by a global network of excited and "well-funded research groups." By contrast, he finds that the social sciences are making much slower progress and lack optimism and communication among researchers. Wilson concludes that the "crucial difference between the two domains is consilience: The medical sciences have it and the social sciences do not." He states: "To advance much further," social scientists will have to cross the boundary between the social and natural sciences and trade with the biologists and psychologists they find on the other side "The next step is for economists to free themselves completely, at long last, from the Standard Social Science Model of behavior and take seriously the biological and psychological foundations of human nature...It is in biology and psychology that economists and other social scientists will find the premises needed to fashion more predictive models, just as it was in physics and chemistry that

researchers found premises that upgraded biology."

In considering consilience of the arts with the natural sciences, Wilson writes: "It follows that even the greatest works of art might be understood fundamentally with knowledge of the biologically evolved epigenetic rules that guided them." Similarly, in the case of religion and ethics he finds: "by exploring the biological roots of moral behavior, and explaining their material origins and biases, we should be able to fashion a wiser and more enduring ethical consensus than has gone before."

Wilson emphasizes that our intellectual heritage from the Enlightenment and the ensuing exponential growth of scientific knowledge has given the human species much confidence that we can know the material world, including the mind and human nature. During the next century we will acquire the capacity to direct the course of our genetic destiny, thereby entering the "full volitional period of evolution" of our species. "*Homo sapiens*, the first truly free species, is about to decommission natural selection, the force that made us. There is no genetic destiny outside our free will. Evolution, including genetic progress in human nature and human capacity, will be from now on increasingly the domain of science and technology, tempered by ethics and political choice. Soon we must look deep within ourselves and decide what we wish to become." The decisions concerning our "collective meaning and purpose" are urgent because they determine our critical collective decisions about the environment. Humanity is faced with dilemmas which "spring from the clash of two opposing [western] human self images..[The first of these images is the] naturalistic self image, which holds that we are confined to a razor-thin biosphere within which a thousand imaginable hells are possible but only one paradise. What we idealize in nature and seek to re-create is the peculiar physical and biotic environment that cradled the human species. The human body and mind are precisely adapted to this world, notwithstanding its trials and dangers, and that is why we find it beautiful."

The opposing exemptionalist view holds that "our species exists apart from the natural world and holds dominion over it. We are exempt from the iron laws of ecology that bind other species. Few limits on human expansion exist that our special status and ingenuity cannot overcome. We have been set free to modify Earth's surface to create a world better than the one our ancestors knew."

Wilson contends that the most important learning from the Biosphere II project was that the human species (and the environment which is essential for its survival) is more vulnerable than we had believed and "scientific entrepreneurial genius" cannot solve the global environmental crises which we are creating by overpopulation, pollution, and abuse of natural resources.

He argues that science distinguishes itself from all other disciplines in that it has been the most efficient in accomplishing what it set out to do. If other disciplines want to do this they need to adopt the methods of the natural sciences. The reductionistic analysis employed by the natural sciences is efficiently and effectively yielding knowledge about the material world.

It is his position that our success as a species depends on the wisdom to make the decisions that honor the choices necessary to meet the intrinsic needs of our fundamental human nature. The next few decades are pivotal in determining our future as a species. We

need to identify those elements of our fundamental nature that define our most basic needs as human beings and then have the wisdom to preserve those things in order to conserve our humanity and our environment.

Consilience of the natural sciences and other disciplines--the social sciences, the arts, ethics and religion--is needed if this challenge is to be met in time, i.e., before we "wreck the planet" or make universal decisions about our genetic future.

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COULD A GOOD BOOK ABOUT MAMMALS HAVE BEEN BETTER?

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The Smithsonian Book of North American Mammals edited by Don E. Wilson and Sue Ruff. Smithsonian Institution Press, Washington and London. 1999. Published in association with the American Society of Mammalogists. $75.00

General Comments: This book is a compilation of species and accounts for all mammal species, except man, that occur naturally in North America, north of Mexico. It is really a book of continental U.S. and Canadian mammals for it does not cover the entire continent as a geographic entity or the Nearctic as a biogeographical unit. This is not really a criticism, however, for it has become traditional to use "North American" in the sense used here, although it may imply a somewhat unjustifiable dismissal of the Mexican and Central American fauna.

The audience for which this book is intended is not readily apparent. The volume seems to be trying to walk a tightrope between technical works such as Hall's (1981) *Mammals of North America* and popular volumes like the almost simultaneously published Forsyth's (1999) *Mammals of North America: temperate and arctic regions*, or earlier similar works. More tightroping resulted from the fact that, by the editors' own statement, this book was "not intended to be a field guide." Certainly, another field guide to North American mammals would be superfluous, there being two fairly good recent ones by Burt and Grossenheider (1998) and Whittaker (1996). Because the book has some characteristics of a coffee table tome, one might get the idea that it was targeted at the casually interested. For just what kind of audience was this work intended? The only hint we get from the editors is the statement on page xxiii that "each account should be easily accessible to all readers," perhaps meaning "all who read it," "all who read," or "all for whom it is intended." It is easy to see that many of the authors were in a quandary about how much to write and at what level to address the audience. This is evidenced in the account of the western harvest mouse (p. 539) where the author decided to describe the home range as "half the size of a football field." On the other hand, in the account of Hector's beaked whale, the generic name *Octopoteuthis* is used alone, without common name, as if all readers will immediately recognize it as applying to an unusual eight-armed squid. No matter what the original aims, as the information that follows will show, the book is too much of a hodgepodge of levels to

be completely accessible or optimally useful to any given group of readers. There is really no good reason for books to be "accessible to all readers." If scientists want to popularize their fields they should write good popular books, not try to create a crossbreed book that will be useful to both scientists and third graders.

Marketability is perhaps another factor driving the hybrid nature of this book. A work on North American mammals that was optimally useful for mammalogists would not sell nearly as well as one that would appeal to the masses. Perhaps this is the reason that Ms. Ruff, the second editor, who is a freelance researcher and writer, was asked to join in on the task.

The editors stated that they followed Wilson and Reeder's (1993) *Mammal species of the world: a taxonomic and geographic reference*. This is perhaps understandable since one of the co-authors of the latter work is also a co-editor of the work reviewed here. Wilson and Reeder's book, like this one, was also published by the Smithsonian Institution Press. Even so, I would have liked a few more sentences explaining why a checklist pertaining specifically to the area covered, and published more recently than the mentioned work, i.e., Jones, et al. (1997) would not have been a more appropriate choice on which to base the list of species covered. Although this work may not have been available in final form when work *on The Smithsonian Book of North American Mammals* was initiated, it seems likely that the information could have been made available. It may have made a difference in the taxa included and in the rank of several of the forms.

It also appears that some information published since Wilson and Reeder's 1993 work was given little consideration. For instance, the work reviewed here recognizes *Sorex jacksoni* as distinct, even though Rausch and Rausch (1995) found what seems to be compelling evidence related to karyotype, genitalia, and incisor morphology that this taxon is conspecific with *Sorex cinereus*.

In another case, merely related to being right, Aplodontidae is used for the sewellel family instead of the correct Aplodontiidae (the double "i" being necessary to conform to the provisions of the Code relating to formation of family-group names). However, what names one wants to use are, to a degree, a matter of choice and it appears that the editors decided to consider Wilson and Reeder (1993) to be authoritative. I will not belabor here the many other opinions or findings that could have been considered.

One rather disturbing theme seems to run through the book or at least is evidenced in many of the accounts. Many authors apparently consider molecular and chromosomal data holy, worshiping information from these sources as if it were just carried down from Mt. Olympus by Hermes. Running along with this theme, and maybe related to it, is the tendency to want every allopatric population to be a distinct species. It is a simple fact that every population of every organism on earth differs in some way from every other population of that type of organism, when subjected to close scrutiny. The presence of differences does not a species make. This trend seems to portend an unfortunate return to typology.

I get the impression, not directly based on anything stated in the book, that some of the species accounts were done by mammalogists who were "talked into" covering the species, or who agreed to do so when no real expert on the species could be found, perhaps at the last minute. This is evidenced by the fact that some of the accounts are by individuals

who have never studied certain of the species for which they authored accounts nor ever worked or resided for any length of time at sites within its range. This is perhaps inevitable in an ambitious work such as this, especially if deadlines were involved. But it seems to have caused some of the species to have been given unjustifiably short shrift.

For each order and family there is a short introductory portion. Some of these are helpful in introducing the taxon. Others are too short or imbalanced. For instance, in the introduction to the Sciuridae, a third of the space is spent on flying squirrels and another third on tree squirrels. The majority of the species (chipmunks, ground squirrels, etc.) are dispensed with in one short final paragraph. I am not precisely sure of the purpose of the introductory portions for orders and families. In some cases, ordinal and familial characteristics are noted. In others they are not. Usually, the number of species in the world and in North America is mentioned, but sometimes, as with the Geomyidae, the number of species covered by the book is left out. I wonder if introductory sections for genera would have been helpful? For some reason there is one for *Dicrostonyx* but not for any other genus. Naturally, introductory sections would not have been needed for monobasic genera.

Misspellings, lapses calamorum, memory lapses, and errors of grammar, form and typesetting are very rare. This is an indication of a book of high quality. As examples of the few errors of this type that exist I point to the misspelling of Physeteridae (p. 239), the use of *Lithospermum* instead of *Lithocarpus* (p. 371), making groundhog two words (p. 399), the use of a scientific name in the possessive form (p.610), the erroneous hyphenation of haypiles (p. 633), misspelling the specific epithet of *Erythronium grandiflorum* (p. 645), misspelling the specific epithet of the cottonmouth (p. 652), the statement that Mobile Bay is in Mississippi when it actually lies in Alabama (p. 684), and the rather large number of cases in which authors abbreviated a generic name when it was the first word of a sentence (examples on p. 612).

Minor biological errors and small errors of fact are also rare. As examples, I note that cottongrass, *Eriophorum*, is called a grass but is actually a sedge (p. 639), and "stonyx" is said to mean claw whereas the proper root is "onych," or "onyx," the "st" not being a component of the Latin root (p. 658). Not being a mammalogist, it was not possible for me to detect problems with the detailed mammalogical components of the book. Other possible mistakes or errors are mentioned in the discussions of the various sections.

This book has been reviewed elsewhere. The review published in the *Journal of Mammalogy* (Wilkins 2000) is one typical of reviews of books in a field done by individuals working in the field and published in a major journal in the field. In this case, the American Society of Mammalogists was also associated with the publication. Under these circumstances it has become traditional to support colleagues and look favorably on the efforts of fellow scientists. There are two statements in this review that I must take minor issue with. First, the species accounts are not "of 1-4 pages." Many are significantly less than one page in length and some are less than half a page (example: *Sorex jacksoni*). Second, according to my experiments, and I believe, in the opinion of anyone who thoroughly considers the usability of the book, it is clearly not accessible simultaneously to a wide range of audiences, unless what is meant is that one section is accessible to one audience and another to a quite

different audience. Still, as reviews go, the author of this one did a much better job and provided much more information than most.

Common and Scientific Names Chosen: I have no real complaints about the common and scientific names chosen. However, I do have two questions. Would it have been appropriate to include the authors of the species? As a general principle of scientific writing, it was traditional, throughout most of this century to include the author the first time a binomen appeared. It helps professionals who know something about the author and who may be able to make judgments or more easily find literature if the author's name is present. It would make little difference to laypersons reading the book.

Second, should we think about getting away from using common names which incorporate the names of people? They are hard to remember for most. The people are usually commemorated in the scientific name and don't need additional recognition in the common name. Although Preble's shrew is not restricted to the Malheur region, the alternative name of Malheur shrew at least provides some hint about its range and habitat preferences. Why we use the common name Keen's myotis for *Myotis keenii* but do not use Lieb's myotis for *Myotis leibii* is difficult to comprehend for many readers. To those who don't understand that sometimes the common name commemorates the author rather than the person whose name appears in the epithet, the name Fraser's dolphin for *Lagenodelphis hosei* will be completely befuddling. Let's get rid of common names that commemorate people. For those who want to keep the commemorated person alive in the vernacular, they can do so in slang names, such as "beechey" for the California ground squirrel.

Species Accounts - Text Portion: I enjoyed reading most text portions of the species accounts. However, I am puzzled by the great variation in length. I think that the editors should have worked to produce more uniformity in length and in information included. For instance, why should the text portion of the account for *Marmota caligaster* use nearly two pages but that for the better-known, longer-known, and more widespread *Marmota monax* use less than a page. It is clear that the editors allowed authors considerable leeway in choosing how long a text portion should be written. In this case, it resulted in much less information being available about the woodchuck than should have been.

In another case I am equally puzzled. The short treatment for *Reithrodontomys humilis* was written by an author who tended to produce very short accounts. However, many of the species dealt with by this author were not well-known or widely distributed. In the case of the eastern harvest mouse, the brevity seems to have been a result of the desire to be brief, not the result of a paucity of information. It may be that the author was pressed into doing this account at the last moment. Because I know this author very slightly and because he is well respected, I assume that the brevity was not the result of lack of knowledge about information in the literature, for there are several life histories and other works present which could have been used to expand the account. Here again I wonder to what extent deadlines and time available affected account length and completeness.

All in all, the text portions of the accounts are as variable as one could imagine. Almost no two by different authors are alike in what they include, emphasize or elaborate on.

This makes the book as a whole a patchwork. As an example, from the text account for Belding's ground squirrel I can obtain considerable information on pelage, habitat, elevation occupied, foods and feeding, hibernation, weight gain and loss during hibernation, alarm calls, alarm behavior, mating, gestation, the features of young, and longevity. On the other hand, in perusing the account for the Mexican ground squirrel, I find no details on alarm call or alarm behavior, essentially nothing about mating or the features of the young, nothing on longevity, and only very sketchy information on anything. It is undoubtedly true that the amount of information in the literature on these two species is not equal, but searching has revealed that much more could have been said about the Mexican ground squirrel. Available literature includes the description of a new coccidian from this species (McAlister et al. 1991), a laboratory study of behavior (Mandier and Gouat 1996), a study of growth and development of litters, information on sexual variation (Yancey et al. 1993), and a 31 page general life history (Valdez and Cevallos 1991) A simple search of the Web revealed more information than was presented in the account, at URLs such as http://www.nsrl.ttu.edu/tmot1/spermexi.htm,

One more example struck me. The text portion of the account on Richardson's collared lemming, a species restricted to a sparsely inhabited region of Canada, is significantly longer than that on the muskrat. This is puzzling since in a cursory literature search I found no recent papers on the lemming but 110 recent papers on the muskrat. Why did the editors allow the muskrat to be short-changed and/or the lemming account to run to greater length than warranted?

It was a bad idea to allow each author to have complete control of the length and inclusiveness of the text portion of the accounts. Claiming that this gives freedom of expression to the authors is not valid because the goal in this work should have been to present information, not to allow the whims and vagaries of each author to create chaotic inconsistency. Lack of standardization in the text accounts is demonstrated by the fact that some authors used common names alone when referring to plant species whereas others added the scientific names. Some authors were inconsistent within their own accounts, one author calling *Sorex dispar* the long-tailed shrew in the account he wrote about it but calling the same species the rock shrew in the account he wrote about *Sorex gaspensis*. In some genera, such as *Sylvilagus*, I found all of the accounts to contain less information than I would liked to have seen. In light of the great variation in length, topical coverage, and writing style, the statement in the Acknowledgments that the "individual accounts were edited for style and consistency," is very difficult to understand.

Recent Synonyms: It appears that the meaning of "recent" in the title of this section was left up to the authors of each account, and maybe that is O.K.. Some listed synonyms have not appeared in the primary literature in the past century, as far as I can determine. Others apparently failed to include synonyms that have been used relatively recently. I don't think of this as much of a problem but the synonymy is not detailed enough to be useful to the professional and is of little value to or not understood by the layperson. Hence, its presence in the book may be superfluous.

Photographs: The photographs are a strong point of this book and most are very good. Photographs for most species are present and most are in color. The photographs of poor quality are, for the most part, of species difficult to photograph because they are rare, secretive, marine, or were described only recently. I am not sure why color photos of the margay, wolverine, eastern spotted skunk, and golden mouse could not be obtained. An exception to the general high quality of the photographs is the horrible picture of the muskrat, better ones being available from a dozen sources that I know of.

In cases in which more than one picture of a species appeared within an account or elsewhere in the book, the extra pictures were only worthwhile if they showed something that the first picture in the account did not. Because of this, the elk, seal, and arctic hare in the front were of little interest. The armadillo picture in the Preface and the raccoon picture before the Acknowledgments were of no value. Cutesy raccoon pictures are so commonplace that one more tends to evoke nausea rather than joy, as if one had unknowingly purchased an oversize copy of Ranger Rick. The black bear in the Plan of the Book section is mundane. The mother opossum with young in the opossum account would have been enough without adding the single baby picture and the one before the Didelphimorphia beginning. Orders with only one species seemed to stimulate the use of repeated pictures of similar value and information content. In contrast, the desert shrew picture at the beginning of the Insectivora is a worthwhile addition to the visual content of the book. The additional picture showing the teeth in detail, in the account of the western mastiff bat, provides valuable information. The presence of two pictures in the white-tailed jackrabbit account aids the reader in understanding the seasonal pelage differences described.

In general, whole body shots are more illustrative and helpful than are more aesthetically pleasing shots of animals peeping out of holes or sticking their head out of the water. For a person who wants to know what a beaver is like, the picture on p. 549 is of little value. With the tail and feet not visible, to the layperson this could be a shot of anything from a capybara to a giant lemming. I will not belabor this issue at any more length. The pictures could have been chosen with a bit more deliberation, but the photographic content of the book is outstanding. I would have bought the book just to see the fin whale picture on p. 254 or the shot of the salt marsh harvest mouse in the *Salicornia* on p. 562.

Size: This section was well standardized and did not use up space superfluously. I have no other comments on this component.

Identification: Although most of the accounts had sections on identification that contained useful information, the length of these sections varied without logical reason. Some authors just decided to go into more detail and separate the taxon discussed from a greater number of other taxa than did others. Some failed to give significant distinguishing features at all. *Baiomys taylor*i is differentiated from a Mexican congener but little is said about how to tell it from sympatric small rodents.

Status: For all but a few of the accounts, the section on status fails badly. The editors' statements on the Status section in the Plan of the Book imply that this section has something to do with the prospects for continued existence and with the conservation needs of the species. In conservation circles, i.e., for most of us, "status" has to do with to whether or not a taxon is declining, increasing in numbers, or remaining stable. The status section could have and perhaps should have addressed threats and reasons for current problems. If some populations in some portions of the species range are declining and others are not, this should have been mentioned. Unfortunately, most authors confused "status" with "abundance." Some made statements with little or no information content such as "common within range." Descriptions such as "locally common" could mean that the species is declining in some areas of its range.

Perhaps there was no room for long statements on status but it seems that it would have been possible for authors to provide small amounts of valuable information as was done in the accounts of the Texas kangaroo rat and the pygmy rabbit.

Subspecies: This section is almost completely superfluous. The range information is too limited and often too general to be of value to professional field biologists and conservationists. Few laypersons understand or have an interest in a list of trinominal names. Hall (1981) seems to have been the source for most of the information in the subspecies section. In fact, it seems that some authors may not have looked for subspecies information elsewhere. The subspecies *Microtus pennsylvanicus dukecampbelli*, a taxon described since Hall's work (Woods et al. 1982) and protected as endangered since 1991, is not included in the list of subspecies for the meadow vole.

Subspecies presumed extinct were included in some cases but not in others. For instance, the badlands bighorn, *Ovis canadensis auduboni*, extinct since the 1920s, does not appear in the subspecies list for the bighorn sheep. The peninsular bighorn, *O. c. cremnobates*, now protected as endangered, doesn't appear either, although a few hundred remain. It is possible that the authors decided that these subspecies were not worthy of recognition but this is only alluded to in the case of the badlands bighorn by a statement including the phrase "possibly of a subspecies different."

There was not room in the accounts to adequately describe the range of the subspecies. Hence, in only a few cases are the ranges distinguished to the extent that the information is of any value at all. Listing the subspecies alphabetically rather than in some geographical order further interferes with what little use the listing may have. In many cases the range descriptions are completely useless and ambiguous. What can a reader obtain when the range description of *Ondatra zibethicus bernardi* is listed as "southwestern United States" and the range description of *O. z. goldmani* is also listed as "southwestern United States?" The professional biologist obtains nothing from this and has better sources of information. The very few laypersons who might read the descriptions get the idea that two subspecies of the muskrat both occur in the same area. Vague and imprecise descriptions of the ranges of subspecies are the rule throughout the book. I can hardly blame the authors. Were they to

have described the ranges accurately, the subspecies sections of the accounts would have taken half of the space in the book.

In addition to the fact that the subspecies information is of little value to anyone, the space taken by the subspecies portion is often so much that it constitutes an inappropriate waste of space, especially in light of the other information that was left out. (See comments on the References section). Among vertebrate zoologists, mammalogists are notorious for recognizing too many and rather poorly differentiated subspecies. The microgeographic races of *Thomomys* that were described earlier in the century still plague authors in the present book. Listing the fifty-five subspecies of *Thomomys talpoides* takes up almost an entire page. Even in other genera the subspecies listings take up inordinate amounts of space. In the *Dipodomys merriami* account, the subspecies listing is as long as the text account. The twenty-five subspecies of the red squirrel occupy over a third of a page.

The subspecies section should not have been included. I cannot understand why the authors of the accounts even agreed to participate in this section. Some quick calculations indicate that for this book, which retails at $75.00, the subspecies listings alone may cost about $5.50, i.e., one is throwing $5.50 away. One of my colleagues thought that the subspecies listings may have been included to increase the length of the book and thus increase its price. (He was not making an accusation of lack of ethics, merely alluding to what is known to be common "strategy" among the publishers of semi-popular books.) I disagree. I believe that here again the fence-straddling between a book useful to professionals and one of interest to the public at large just resulted in a bad decision.

Range maps: I am very puzzled by the decisions that were apparently made as to how to handle the range maps. On the surface, it may seem logical to decide that standardization of the maps is a good idea and all ranges should be depicted on a base map of all of North America. But there is absolutely no logic in such a decision since it will clearly prevent the maps from having maximum information content and will make many of them inaccurate.

In order to determine the accuracy of the maps, I scanned a base map of a Mercator projection of North America that seemed to be identical to the one used but which contained outlines of the Canadian provinces and U.S. states. I reduced this map to the size printed in the book and transferred it to a transparency so it could be used as an overlay to check the accuracy of the maps in the book. Most are not very accurate and many are inaccurate. It seems as if none of the maps were checked before publication. If they had been, many of the mistakes would have been caught. For instance, the maps of *Liomys irroratus* and *Oryzomys couesi* indicate that these species do not occur in the United States.

Was it the intention that the maps depict the original range of the species or the present range? The authors and the map maker were clearly given no instructions on this. It appears that the maps for *Gulo gulo* and *Cervus elaphus* depict the present range and do not show areas where the species may have occurred earlier. On the other hand the maps for *Bison bison* and *Martes pennanti* appear to depict original ranges rather than present ones. This could cause some confusion among readers.

The decision to use the same base map was inappropriate. I have experimented with using the same amount of space to depict the ranges on maps of larger scale, as was done by

Hall (1981) and Burt and Grossenheider (1998). It was possible in all cases to use the same space to depict the ranges with more accuracy and visibility, although the option to change the shape of the area used would have allowed even better results. With the scale used in the book, it is often impossible to pick out small disjuncts. No one that I asked noticed the Point Reyes and Point Arena populations of *Aplodontia* on the range map and some could not even see them without magnification.

References: I agree with Michael Hutchins of the American Zoo and Aquarium Association who in his review (at http://www.aza.org/Communique/00-02/8.htm) was disappointed with the limited number and age of the references and said that it would be "very difficult to use this book as a conduit to the existing literature." It is understandable that space needs would preclude exhaustive lists of citations. However, much of the space used for subspecies lists could have been more profitably used for references. Some of the accounts list only one reference. In cases in which the *Mammalian Species* account is the only one listed, many readers who have access to only small community and high school libraries are unable to go further to satisfy the interests that this book may have stimulated, for most small libraries do not receive *Mammalian Species*.

Other problems are created by the paucity of references. One is simply the failure to credit past workers for their intellectual contributions. In a number of cases I found that significant portions of the information in an account came from works by authors who were not cited. Claiming that these workers are probably cited in the *Mammalian Species* account is not valid because some of the *Mammalian Species* accounts are quite old and out of date.

Another problem is that the sources of some information seem to not exist. The statements about the possible linkages between consumption and dispersal of hypogeous mycorrhizal fungi and the welfare of the trees on which *Sciurus aberti* depends fascinated me when I read it. I looked in all of the references listed and found no information on this subject. I searched elsewhere and found nothing. If the author had listed a reference for this information or noted it as personal conjecture I may have been able to follow the subject somehow. I issue a plea for the editors to consider expanding the Reference section and eliminating the Subspecies section in the next edition.

Common and Scientific Names of Plants Cited: This section was fairly complete and well done.

Glossary: Glossaries are notoriously difficult to create and although traditional are of unproven worth. No one I talked to had consulted the glossary in this book. A major problem with this glossary is that the choice of words to include seems to have been made without logic. If it is true that a word like "underparts" needs to be defined for the reader, which it is, then half of the words in this volume should be in the glossary. On the other hand, if terms like allozyme, baculum, baleen, chromosome, DNA, gestation, implantation, molt, rookery, sibling species, subspecies, and Upper Sonoran Life Zone are not included in the glossary, and they are not, then maybe it can be assumed that all readers are erudite biologists who don't need a glossary.

The definitions themselves are relatively satisfactory with the exceptions noted below:

1. Neither **amphipods** nor **copepods** comprise a family of crustaceans. Amphipods are usually regarded as an order of the class Malacostraca. The copepods are most commonly considered to comprise a class. In case the definitions were trying to use "family" in the vernacular, I point out that throughout the book the word is used to denote a specific taxonomic category and the taxa in that category.

2. The **hallux** is the first or innermost digit of the pes and in most mammals is not opposable.

3. **Polygamous** does not refer to a mating system in which both sexes mate with more than one mate of the opposite sex. Rather, it is a term including both polygynous and polyandrous. It means that members of one sex mate with more than one member of the opposite sex, but members of the opposite sex have only one partner. Polygamous species may be either polyandrous or polygynous. Cases in which members of both sexes mate with more than one mate of the opposite sex are usually referred to as promiscuous.

I think that some of the shortcomings of this book are due to a failure by the editors to issue instructions that would have resulted in greater uniformity of treatment of the species. The variation present in the various components is not appropriate in a book of science.

It may be a bad idea for a professional scientist and a professional writer to work together in developing a concept for and editing a book. I can see how such an arrangement would result in one always diluting and modifying the wishes of the other, resulting in a book that is not optimally suited for professionals or for the general public. I would suggest that, in the next edition, priority be given to suitability for biologists, conservationists, agency personnel, and other professional and semi-professional workers. The book by Forsyth (1999), mentioned earlier, is superior to the book reviewed here in accessibility. Thus, that niche is now occupied.

It is possible, perhaps even likely, that my view of this book is merely a result of my age and the biological era in which my ideas were formed. I know that passion about mammals has been largely replaced by an apparent or feigned fondness for probabilities and numbers. Current graduate and undergraduate students interested in mammalogy no longer consider Burt and Grossenheider to be good bedtime reading. Pronouncements by those who have never seen a species are valued more than lifetimes of experience by field biologists. In these times there are many who value precise and detailed knowledge little because it does not contribute to their careers. Their fate and their strivings are governed by Deans, Department Heads, Committees, upper level administrators, and frequently by journal editors and manuscript reviewers whose grasp of the path to knowledge ranks with their comprehension of the details of the orbit of Pluto, and whose comments include inanities like, "But you failed to challenge paradigm," "This is not experimental!, "and "You need some molecular data." But I still take heart in the fact that in this book there is considerable

evidence of a love of mammals, which may eventually lead to an understanding of this wonderful group of beings.

The Smithsonian Book of North American Mammals is a good book and in some ways a very good book. In these times it can be little more. Great books about mammals have gone the way of Steller's seacow.

LITERATURE CITED

Burt, W. H., and R. P. Grossenheider. 1998. A Field Guide to the Mammals : North America North of Mexico (Peterson Field Guides) 3rd ed. Houghton Mifflin Co, Boston.

Forsyth, A. 1999. Mammals of North America : Temperate and Arctic Regions. Firefly Books, Westport, CT.

Hall, E. Raymond. 1981. The mammals of North America. 2nd ed. John Wiley and Sons, New York.

Jones, C., R. S. Hoffmann, D. W. Rice, R. J. Baker, M. D. Engstrom, R. D. Bradley, D. J.Schmidly, and C. A. Jones. 1997. Revised Checklist of North American mammals north of Mexico, Occasional Papers, Museum of Texas Tech University, Number 173, 19 December 1997.

Mandier V., and P. Gouat. 1996 A laboratory study of social behaviour of pairs of females during the reproductive season in *Spermophilus spilosoma* and *Spermophilus mexicanus*. Behavioural Processes. 37:125-136.

McAllister, C.T., S. J. Upton, and B. D. Earle. 1991. *Eimeria callispermophili* and E. morainensis (Apicomplexa: Eimeriidae) from the Mexican ground squirrel, *Spermophilus mexicanus* (Rodentia: Sciuridae), in south central Texas, U.S.A. Transactions of the American Microscopical Society 110:71-74.

Rausch, R. L., and V. R. Rausch. 1995. The taxonomic status of the shrew of St. Lawrence Island, Bering Sea (Mammalia: Soricidae). Proc. Biol. Soc. Washington, 108:717-728.

Stangl, F., Jr., B. J. Brooks, and C. B. Carr. 1995. Observations on comparative growth rates and early development in two litters of the Mexican ground squirrel, *Spermophilus mexicanus* (*Rodentia: Sciuridae*). Texas Journal of Science. 47:308-314.

Valdez, M., and G. Ceballos. 1991. Natural history, diet, and reproduction of the ground squirrel (*Spermophilus mexicanus*) in an intermontane meadow. [original title in Spanish]. Acta Zoologica Mexicana Nueva Serie. 0(43):1-31.

Whitaker, J. O., Jr. 1996. National Audubon Society Field Guide to North American Mammals, Alfred A. Knopf, Boston.

Wilson, D. E., and D. M. Reeder. 1993. Mammal species of the world: a taxonomic and geographic reference. 2nd edition. Smithsonian Institution Press, Washington, DC.

Woods, C. A., W. Post, and C. W. Kirkpatrick. 1982. *Microtus pennsylvanicus* (Rodentia: Muridae) in Florida: A Pleistocene relict in a coastal saltmarsh. Bull. Florida State Museum, Biol. Sci. 28: 25-52.

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Journal of the Alabama Academy of Science, Vol. 70, No. 4, October 1999.

MINUTES
ALABAMA ACADEMY OF SCIENCE
FALL EXECUTIVE COMMITTEE MEETING
Southern Research Institute
Birmingham, AL

Saturday, October 2, 1999

A. Dr. Larry Boots, President of the AAS, called the Fall Meeting of the Executive Committee to order at 10:00 a.m. The minutes of the Spring meeting were approved with changes.

Members present: Michâel Moeller, William Boardman, Frank Romano, Larry Davenport, Rigoberto Advincula, B.J. Bateman, Jr., Donald W. Salter, Larry Krannich, Dan O'Donnell, Gerald P. Fisher, Helen Benford, Jim Bradley, John Tarvin, Dail Mullins, Alan Sprague, Mary Thomaskutty, Jane D. Nall, Roland Dute, Ricahrd Hudiburg, Sam Barker, William J. Barrett, Larry boots, Levin Hazelgrove, and Priscilla Holland.

B. Officers Reports

1. Board of Trustees--Dr. Barker introduced the Board of Trustees members present: Mike Moeller, William Barrett, and Sam Barker.

2. President Larry Boots submitted the following written report.

Following is a brief summary of the activities of this office since the Spring annual meeting.

1. Coordinating activities with Dr. Larry Davenport, Chair Local Arrangement Committee and Dr. Lev Hazelgrove, Executive Director of the AAS regarding the site visit June 25 at Samford University.
2. Accepted the invitation by Dan Holliman for the steering committee dinner and meeting at Birmingham Southern College, Friday, October 1, 1999.
3. Coordinated the arrangements for the Fall Executive Committee meeting at Samford, October 2, 1999, with Drs. Davenport and Hazelgrove.
4. Have arranged for Dr. Ken Marion to present the program at the annual Banquet this year.
5. Have filled some of the committee positions that were vacant and continue to seek other volunteers.

3. President-Elect Dr. Richard Hudiburg submitted the following written report.

I developed an ad for the Alabama Academy of Science and Alabama Junior Academy of Science to be placed in the program for the October 1999 annual meeting of the Alabama Science Teachers Association.

I have had discussions with the Chair of the Committee on Research, Anne Cusic of UAB concerning the development of webpages for the various student research competitions.

I would like to establish as a goal for AAS to increase electronic connectivity via e-mail and web pages on the Internet. Currently 201 of the 597 members of AAS have e-mail addresses in the membership database.

4. Second Vice President Dr. Roland Dute submitted the following written report.

One of the duties of the Second Vice President is to learn the workings of the academy. With this in mind, I have had discussions with Dr. James Bradley regarding the issues facing the AAS Journal. One concern is the small number of submissions. We agreed that a letter from the editor on the frontispiece of the next issue asking for submissions would be in order. In addition, Dr. Bradley has contacted Dr. Jandebeur about publishing the proceedings of the symposium from last spring. Dr. Jandebeur has contacted the other presenters, and the response has been positive. Dr. Bradley has placed a deadline of mid-October for the receipt of manuscripts for publication.

5. Secretary Dr. Priscilla Holland submitted the following written report.

ALABAMA ACADEMY OF SCIENCE
Secretary's Report - October 1, 1999

597 Members
7 New Members 4/1/99 to 9/30/99
46 Lifetime Members

SECTION	MEMBERS
Section 1 Biological Sciences	78
Section 2 Chemistry	64
Section 3 Earth Science	30
Section 4 Geography, Forestry, Conservation and Planning	27
Section 5 Physics and Mathematics	59
Section 6 Industry and Economics	28
Section 7 Science Education	26
Section 8 Behavioral and Social Science	34
Section 9 Health Sciences	62
Section 10 Engineering and Computer Science	34

Section 11 Anthropology	8
Section 77 University Libraries	28
Section 88 High School Libraries	2
Undesignated	17

6. Treasurer Larry Krannich submitted the following written report.

The treasurer's report consists of copies of the following:
All Account Balances as of September 27, 1999
Income & Expense Statement as of September 27, 1999
Activities Relative to 1999 Budget for the period 1/1/99 through 9/27/99
Treasurer's Summary Report by Quarter 91/1/99 through 9/27/99)
Treasurer's Summary Report by Account (1/1/99 through 9/27/99)
Proposed Budget 2000 vs 1999

The total funds in all accounts have increased by $19,284.09 since the 1998 Fall Treasurer's Report. Roughly $10,000 of this is due to the receipt of revenues from two annual meetings since September 1998 and almost $7,000 less in expenditures. Dues revenue for these nine months in 1999 is equivalent to what it was for the same time frame in 1998 and we should expect the traditionally active fourth quarter for dues collection. As reported in March 1999, the support for the journal appears to be lower than anticipated, actually $2,700 was received in the fourth quarter of 1998 for 1999 support. Thus, total support for the Journal in 1999 is $3,700; a decrease from that projected. In the Gorgas, Science Olympiad, and Science Fair categories, we receive funds which offset the expense in these categories.

On the expense side, we are and expect to finish this year within budget. This is a consequence of again not receiving invoices for the printing of the Journal, which previously amounted to $14,000 per year. Thus, this is an expense item which could be a major expense in the fourth quarter. On the other hand, we did not receive any invoices last year for printing, except for one ($285) received in January 1999.

A copy of the Proposed Budget for 2000 is also attached. Projected income for journal support has been decreased by $1,000 and the corresponding Associate Editor fee decreased by $100. Also Mason Scholarship projected income has been decreased by $100. Again, the big uncertainty is the printing costs associated with the Journal. If 2000 becomes the third year in a row in which some other organization pays the costs of publication, we will have a balanced budget. A detailed report is available from the treasurer or secretary on request.

Dr. Krannich moved to adopt the treasurer's report, and the motion was seconded by Dr. Frank Romano. Following a discussion of the proposed

budget, Dr. Krannich moved to cut the printing cost down to $7,000. The motion was seconded by Mike Moeller, and the motion carried. A discussion followed regarding the bill for the printing of the *AAS Journal.* Dr. Krannich and Dr. Bradley were given the charge to track down a realistic cost for printing.

7. Journal Editor Dr. Bradley submitted the following written report.

Publication Schedule

Publication of the JAAS is behind schedule. This is due to the paucity of appropriate articles being submitted to the journal. The projected publication schedule for the next 4 issues follows.

October 1998 (Vol. 69 No. 4): October, 1999 (5 papers)
Jan./April 1999 (Vol. 70 No. 1-2, joint): late Nov./early Dec. 1999.

July 1999 (Vol. 70 No. 3): January, 2000 (4-5 more papers needed)
October 1999 (Vol. 70 No. 4): January/early February, 2000 (Karst in Alabama (Symposium)

In the upcoming Oct. 1998 issue, I will include a short letter from the Editor encouraging the AAS membership to support the journal by submitting more articles.

I suggest that Symposium organizers henceforth make a concerted effort to encourage the participants to publish their lectures in the JAAS. I would like to devote one issue per year to a collection of symposium papers from that year's annual meeting.

Auburn University Subsidy of the *JAAS* and Future of the *JAAS*

The Dean of the Library, Stella Bentley, has said that the annual $4000 subsidy of the *JAAS* plus the mailing of the journal will continue only until the next round of budget cuts for the library. She expects that this will happen in 2-3 years.

Dr. Sheila Bentley, Dean of Libraries, Auburn University, has also offered to publish the *JAAS* electronically on an Internet Web site that would be set up and maintained by the AU Library. Her memo to me on this subject is attached as **Attachment #7**.

My suggestion is that we continue publishing hard copies of the JAAS for 2-3 years so long as the subsidy from the AU Library is intact. Thereafter, I suggest that we begin having the *JAAS* published electronically. At that time I recommend that we continue publishing the April Abstracts issue as a hard copy (as well as electronically).

8. Counselor to AJAS Dr. B.J. Bateman submitted the following written report.

1999 Annual Report of the Alabama Junior Academy of Science and the Junior Science and Humanities Symposium

State Officers/Counselors Meeting

The State Officers and the State Counselors met at the University of South Alabama to discuss the State Officer's roles for the upcoming year (1998-99).

Fall Planning Meeting

The Executive Committee of the Alabama Junior Academy of Science (AJAS) did not meet again this year because the state counselor B.J. Bateman was home bound with illness. The State Counselor with permission from the President of the Alabama Academy of Science made minor decisions concerning the annual meeting without consulting the executive committee. No changes in rules, bylaws, etc. were made.

The paper competition again would be held on Friday morning, with the winners announced at the Friday night banquet. The state-wide JSHS paper competition in Alabama falls within the long-established program of AJAS and utilizes the organizational structure of the latter. The AJAS consists of nine regions within the geographic boundaries of the state. The activities of the nine regions are coordinated through nine Regional Counselors, two Associate Counselors, and a State Counselor, utilizing a variety of forms and established deadlines.

Fall AAS Executive Meeting

The State Counselor (B.J. Bateman) was unable to attend because of illness the Fall Executive meeting of the Senior Academy of Science held at the Southern Research Institute October 3, 1998. Mary Thomaskutty attended in his place.

Regional Meetings

Meetings were held in the nine regions of the state prior to December 1, 1998, for the purpose of organizing their regions and strengthening science clubs, discussing appropriate science project work, and reviewing the several aspects of paper competitions.

Annual meeting

The 1999 Annual Meeting, like all previous meetings of AJAS, was shared jointly with the Alabama Academy of Science. The host institution was Athens State University.

Dr. Tom Jandebeur coordinator for the AAS/AJAS meeting, Jennie Legge, local arrangements for the AJAS, B.J. Bateman Counselor to the AJAS, and Wanda Phillips Associate Counselor, planned registration procedures, space needs, and arrangements for the AJAS-JSHS social and banquet. Registration was held at the Hampton. The AJAS Journal and the official program for the Annual Meeting were given to each student.

Highlights of the program were:

(1) Paper Competition -- The paper competition was conducted on

Friday and Saturday mornings in the Classroom Building on the Athens State University Campus. The names of participants and the respective papers are attached.

Stephen Rottgers was chosen to be the overall winner and would therefore represent Alabama in national competition held at San Diego May 13-16. The other four state winners (Bryce Roberts, Amanda Snyder, Kimberly Bartmess, Rachel Rogers) and the State Counselor (B.J. Bateman), would accompany Stephen to San Diego for this competition.

(2) Banquet -- More than one hundred students, teachers, university professors, and members of business, industry and government shared the Friday night banquet at the Student Center Banquet Hall. A major part of the after-dinner program was the recognition of the first and second place winners of the paper competition, and other competitions.

On alternate years the Junior Academy is responsible for the banquet speaker. This year the Alabama Junior Academy of Science provided the banquet speaker, Howard Jones, Professor and Chair of the History Department, University of Alabama, who spoke on Muntiny on the Amistad.

(3) AJAS-JSHS Social Activities -- No formal social activities were planned. The participating schools chose to visit some of the many attractions in the Athens area.

(4) Business Meeting -- The customary AJAS business meeting was held on Saturday morning. This provided a time for awarding a plaque to the outstanding region, a certificate and a check to the outstanding teacher(s), the JSHS Award to the teacher of the overall first place winner and other awards.

AWARDS

Most with the Least Award

BIOLOGY:	Chris Stowers,	Bradshaw
PHYSICAL SCIENCE:	Shwetak Patel,	JCIB
ENGINEERING:	Mathew Taylor,	Bradshaw
HUMANITIES:	Natasha Carter,	Demopolis

Second Place Award

BIOLOGY:	Jamie Aldes	Murphy
PHYSICAL SCIENCE:	Shwatak Patel	JCIB
ENGINEERING:	Katie Clark	Murphy
HUMANITIES:	Jennifer Pritchett	JCIB

First Place Award

BIOLOGY:	Stephen Rottgers	JCIB
PHYSICAL SCIENCE:	Rachel Rogers	Bradshaw
MATHEMATICS:	Bryce Roberts	Altamont

ENGINEERING: Amanda Snyder Demopolis
HUMANITIES: Kimberly Bartmess Bradshaw
Grant for the Bertie Mae Warren Research Awards
Schwatak Patel, Aubrey Walker, Raphael Bollar, Katie Clark, Jordan Farina
AAAS Award
None
Outstanding Region
Northwest
Outstanding Teachers
None

Newly elected officers for 1999-2000:

President:	Raphael Bollar	Sumner Couty High School
Vice-President:	Faiza Ferdousy	Demopolis High School
Treasurer:	Mary Mayberry	Demopolis High School
Secretary:	Rachel Rogers	Bradshaw High School

JSHS participants attending the Annual Meeting
63 students, sponsors, and counselors attended the annual meeting as JSHS participants (expense paid).

National Symposium and Paper Competition
Stephen Rottgers was chosen to be the overall winner and therefore represented Alabama in national competition and symposium held at San Diego, CA. Four other state winners (Bryce Roberts, Amanda Snyder, Kimberly Bartmess, Rachel Rogers), Regional Counselors Mary Thomaskutty, Linda Kanipe, Cynthia Tillery, Donna Harrison and the State Counselor (B.J. Bateman) accompanied Stephen.

9. Science Fair Coordinator Mary Thomaskutty submitted the following written report.

Dear Senior Academy Members:

Enclosed you will see a list of Alabama winners for 1999 ISEF. We had a good trip but it was a very long trip. The trip took over 24 hours. We got back Sunday morning around 3:00 a.m. Next year's ISEF will be in Detroit, Michigan from May 7-14, 2000.

Jeb Orr--Alabama School of Math and Science--Mobile Regional Fair
American Chemical Society 1st Place Award of $500.00
U.S. Air Force 1st Place Award of $3,000.00, a medallion,and a Certificate of Recognition
Holli Hitt-Tuscaloosa County H.S.-West Alabama Regional Fair (UWA)
American Geological Institute Honorable Mention
Association of Women Geoscientist Award $150.00 cash award
Bryce Roberts--Altamont High School--UAB Fair

American Mathematical Society Honorable Mention, received a certificate
Eastman Kodak Honorable Mention Award of $100.00
National Taiwan Science Education Center Third Place Award of $100
Leah Brown--Covenant Christian Academy--North Alabama Fair
American Statistical Association Honorable Mention
One-year subscription of "STATS" and "Chance" data analysis Computer software and books selected by ASA.
Student's school also received computer software, books and one year school membership in ASA.
Christopher Stower--Bradshaw High School--North Alabama Fair
Category Award--Environmental Science 3rd Place Award of $1,000.00
John Mays--Altamont School--UAB Fair
Category Award--Gerontology 4th Place Award of $500.00
Taylor Griswold--Trinity Presbyterian School--Troy State University
National Aeronautics and Space Administration--An all expense paid trip to U.S. Space Camp in Huntsville, AL and a Certificate
Category Award--Engineering 2nd Place Award of $1,500.00

2000 Regional Science Fair Dates

Southeast Regional Fair Dr. Gene Omasta (Troy)
February 26, 2000
Northeast Regional Fair Ms. Gladys Swain (Talladega College)
No Date Given
South Alabama Regional Fair Dr. Amy Schelden (Mobile College
March 9-11, 2000
Central Regional Fair Dr. James Martin (UAB)
March 3-4, 2000
North Alabama Regional Fair Mr. George Williams
No Date GivenDr. Sue Mitchell (Calhoun Community College, Decatur)
West Alabama Regional Fair Dr. Richard Holland (UWA)
March 17-18, 2000
State Science Fair Dr. Grame Duthie (UAH)
April 6-8, 2000

West Alabama Regional Science Fair K-8 Mary Thomaskutty
(Demopolis HS) Grades K-8.
Hope this helps us to encourage our young people to get involved with the fair.

10. Science Olympiad Coordinator Jane Nall submitted the following written report.

Alabama Science Olympiad

1. AL SO has a new web!! http://aso.jsu.edu. Special appreciation is extended to David Peters, an FSU student, former Science Olympiad student and director of ESO at Jacksonville, AL. Thanks to Jacksonville State University for donating the web space. Print out of the site is available.
2. Post card was mailed to every K-12 Public and Private school in Alabama announcing AL SO and the available web pages. Results indicate that
   Participation in "Science at its Best" is increasing!! Sample available.
3. Handbooks for Coaches and Tournament directors have been assembled and are ready for printing when funding is available. Samples available.
4. Director has initiated a "One form, one check" procedure for registering teams. Sample available.
5. Currently, registration for Divisions A1, A2, B, and C is underway. Deadline is December 1, 1999. Dates for all tournaments are set. Including 1 tournament for Division A-1 (K-3), 2 A-2 (3-6), 4-B (6-9), and 5 C (9-12) regional tournaments, and three state tournaments: A1 at Geneva High School, B at University of Mobile, and C at Troy State University. We need every university in Alabama to consider hosting tournaments. State Director would like to eventually develop a rotation system for the state tournaments.
6. There is a possibility that we could send two teams in Division B and/or C to National. The National Tournament will be held at East Washington University, Spokane, WA., May 19-20, 2000.
7. State Director has submitted three proposals for corporate funding. No funding yet!! Tournament sites need some assistance with cost of medals and trophies. To assist new coaches in training the teams for competition, and encouraging present coaches to continue providing these opportunities for their students, coaches' clinics and handbooks are needed. State Director needs funding for postage and phone/fax expenses. Copies of proposals are available.
8. "What has Alabama Academy of Science done for Science Olympiad, lately?" Please consider financial assistance to help the state director carry out these initiatives.

11. Counselor to AAAS--Katherine Mayne --No Report

12. Section Officers

    I. Biological Sciences Frank Romano submitted the following written report.

    The 1999 meeting at Athens State University saw the

presentation of 35 talks and 9 posters in the Biology Section. The talks were grouped into three sessions to accommodate the Karst in Alabama Symposium. The award for best paper was given to Michael C.L. Vickery (M.S. Vickery, J.B. McClintock, and C.D. Amsler, co-authors).

Dr. Frank Romano has succeeded Dr. Roland Dute as chair, and Dr. Donald Salter (U. of West Alabama) was elected as the vice-chair at the annual meeting of the section.

II. Chemistry--Tracy P. Hamilton submitted the following written report, which was delivered by Gohet Advincula.

The 76th annual meeting had 11 talks and one poster in the Chemistry Section. A large number of participants were from UAB, with others from UNA, Athens State, and AUM. The paper competition was keen, with the winner being Eric Johnson, UAB with "Novel solution-phase Parallel Synthesis of Ethers as Inhibitors of Influenza Neuraminidase". Co-authors were Shanta Bantia and Wayne J. Brouillette.

Hopefully, the central location at Samford will encourage more participation from chemists who have not come to meetings in the recent past.

Elections for vice chair will be held at the upcoming meeting, effective next fall, for 2 years. The current vice chair, Gobet Advincula, Dept. of Chemistry, UAB, gobet@uab.uab.edu will assume chair after this spring's 77th annual meeting.

III. Earth Science--Daniel O'Donnell submitted the following written report.

The Earth Science Section was represented with eight poster presentations at the 1999 Spring meeting held at Athens State University. Attendance was down from previous years due to several factors including procrastination on the part of the authors (two responded two weeks after the deadline) and a conflict with regional geological society meetings scheduled for the same time frame.

To combat procrastination, I have already mailed out 38 "Call for Papers" invitations to section members, eight private companies, four state colleges and two state agencies. I have asked recipients to post the invitation and begin preparing now for their presentation. I have also asked the Profession Geologist Board of Alabama to include an announcement for the Call for Papers in their newsletter "Alabama Geologist" and have requested they allow continuing credit units for those that attend and those that present. CEU's were given last year and I expect them to allow credits again this year. I have also contacted the Geological Society of Alabama and asked them to include the announcement in their next issue of "Alabama Geological

Society News", due out in November. Hopefully, this will overcome procrastination, spark a renewed interest in the section and result in more participation from those not currently in the Academy.

As for conflicts with regional meeting, I take it from the discussions at the dinner meeting last spring; we will have to endure the conflicts.

As this is my last "official" fall meeting as chairman of the Earth Science Section, I would like to say goodbye to all whom I have met during my two-year term. I have enjoyed working with you and look forward to staying active through presentations at the annual spring meetings.

Vice-chairman, David Allison will be taking over this coming spring. David is a geology professor at the University of South Alabama. I am sure he will carry on in a manner that works to build membership and strengthen our portion of the spring meeting.

IV. Geography, Forestry, Conservation & Planning--Chukudi Izeogu submitted the following written report.

Section IV of the Alabama Academy of Science has continued to wax strong in the activities of the Academy. During the spring 1999 meeting of the AAS at Athens State University, Athens, Alabama, the section had twelve paper presentations and one poster exhibit. The papers focused on a wide range of subjects including the use and conservation of natural resources, GIS and remote sensing applications, tourism, national and international urban and regional planning, and pop culture. The presentations were made in two sessions followed by the section's general meeting in the afternoon. There was no student research competition this year.

Currently, total section IV membership stands at twenty-seven. There was a significant increase in student membership compared to the previous year.

Section IV faces the challenge of increasing its membership and the number of paper presentations. Every member will be urged to lead out in this effort by recruiting members, particularly students in his or her institution. It will also be necessary to send letters to professional colleagues in institutions where we have no members at present encouraging them to join the Academy and participate at annual meetings by presenting their research papers.

V. Physics and Mathematics--John Tarvin submitted the following written report.

The Physics participation at the AAS Spring Meeting should be good, since the American Physical Society meeting does not conflict with the AAS (as it often does) this year. The Call for Paper titles mailout will include a short letter noting this lack of conflict and an

encouragement to submit an abstract (or abstracts). In particular, student presentations from both the Physics and the Mathematics communities will be emphasized. In addition to this conventional mailing, e-mail contact will be established with those AAS members whose e-mail address is known.

Participation of the Samford Department of Physics, and of Mathematics, Engineering and Computer Science, has already been arranged. Hopefully, this year's meeting will include a wider representation of the State's colleges and universities than just Samford, UAB, and Birmingham Southern.

VI. Industry and Economics--Paulette Alexander, chair--No report

VII. Science Education--Helen Benford presented the following written report.

Ten titles were submitted and nine papers presented in Section VII at the 76th Annual meeting of the AAS in March 1999. This number represents a considerable increase over the previous three annual meetings at which, on average, five papers were presented in Section VII. The paper session was well attended. The contributions of AAS Executive Committee members who attended, presented, and encouraged colleagues to present at Section VII are gratefully acknowledged.

Section VII has a membership of 24 as of March 1, 1999 listing. Of the nine presenters at the last annual meeting, four were affiliated with other sections, not a surprising distribution for an area in which members of various science subdisciplines find common interests. The topics of the presented papers--instructional strategies for college courses in Biology, Nursing and Physics; instructional technology; undergraduate attitudes toward evolution/creationism; collaborative learning; integrated science in the middle school--represent the diversity of presenters' backgrounds.

Section VII continues to invite papers by non-section members involved in curriculum revision, instructional innovation, or other activities that address the challenge of teaching science. We also urge interested members of other sections to list Section VII as their secondary affiliation in AAS.

Section VII encourages a science education theme for the Academy-Wide Symposium at the 2000 meeting at Samford University.

VIII. Behavioral Sciences--Gerald Fisher submitted the following written report.

Our section met on the morning of Thursday, March 25, 1999.

We had nine papers scheduled for presentation. Two of the presenters did not show.

After the session, the Behavioral Science section held an election for chairman. Gerald Fisher was voted chair. Jerald Burns has agreed to remain on as vice chair.

IX. Health Sciences--Barber Wilder, chair--No report

X. Engineering and Computer Science--Alan Sprague, chair--No report

XI. Anthropology--Curtis E. Hill, chair--No report

13. Executive Officer Leven S. Hazelgrove submitted the following written report.

Since the Spring Executive Meeting, March 24, 1999, at Athens State University, we have been working on the following projects during the last six months:

1. Set up and prepared the Gorgas Scholarship Program for Science Talent Search in cooperation with the Westinghouse (Now Intel) Scholarship Science Service, Inc., D.C. for the Samford University, March 31, 2000, meeting with the leadership of Dr. Ellen Buckner, co-chair and Dr. Larry Davenport, local chair.
2. Prepared for bulk mail 700 "Call for Paper Titles" for Samford University meeting for March 29-31, 2000, edited by Dr. William J. Barrett.
3. Sent development letters to 3 industrial companies and foundations with positive reply from one, Vulcan Chemical of Vulcan Materials, $1,000 for 2000.
4. Sent hand written notes and brochures to 25 outstanding Scientists and Engineers, Mathematicians and potential members whose "write-up" appeared in local publications.
5. Site visit with Dr. Larry Davenport, Professor Biology and his local committee for the AAS dates: March 29-31, 2000, at Samford University with Drs. Davenport, Buckner, Asouzu, Bush and Bateman.
6. Prepared 12 abstract forms for the Samford University meeting, March 29-31,2000 for eleven section chairs and 650 printed programs.
7. Your director studied flora, fauna and pollution in the USA, February 10-13, 1999, with the Alabama Fisheries Association, Gulf State Park, with Drs. Marion and Angus.
8. Set up the 77th Annual Meeting with the able direction of Dr. Larry Davenport, Professor of Biology, Samford University, Birmingham, AL, March 29-31 1, 2000.
9. Prepared with Dr. Larry Davenport (205) 726-2574, fax (205) 726-2479, the 77th Annual Meeting to be at Samford University, March 29-April 1, 2000.
10. Trying to get the AL Legislature to grant AAS exemption from sales

11. tax! Anyone know anyone? Setting up ASTA Booth, Hoover H.S., October 21-23, 1999.

C. Committee Reports

1. Local Arrangements--Larry Davenport submitted the following written report.
    1. On 25 February 1998, Samford University agreed to host the AAS meeting, 29 March-1 April 2000.
    2. A committee, consisting of the 11 faculty/staff of Samford's Department of Biology, was formed to plan the meeting; Larry Davenport serves as committee chairperson.
    3. A site visit was held 25 June 1999 on Samford's campus, to preview meeting and banquet facilities; AAS activities will be concentrated on the east end of campus.
    4. Since the site visit, the following details have been secured:
        a. Registration will be held in the foyer of Brooks Hall; refreshments will be available in the nearby faculty lounge.
        b. The general sessions will be held in Brooks Hall and adjoining Buchanan Hall.
        c. Large assemblies will take place in Brooks Hall Auditorium
        d. Displays for the Gorgas competition will be set up in 203 Russell Hall.
        e. Throughout the meetings, free parking will be available in the law school parking deck.
        f. The Wednesday evening Executive Committee dinner will be held in the Flag Colonade of Samford's university center, catered by Marriott.
        g. The Thursday evening social event will take place in the McWayne Center, downtown Birmingham, catered by Sheraton; approximate ticket price is $10.
        h. The Friday evening banquet will be held in Samford's student cafeteria, catered by Marriott; approximate ticket price is $20.
        i. Special AAS rates have been obtained at the motels nearest Samford's campus; blocks of both single rooms and large suites will be available.

2. Finance--Dr. Sam Barker submitted the following written report.

Our Treasurer has presented his usual colorful as well as informative report on the fiscal status of the Academy. The most comforting aspect is shown on the white page of "All Account Balance" revealing total assets of $76,219. This is an increase of $6,007 since the end of 1998. Dr. Krannich has emphasized an increase of $19,284 since the 1998 fall Treasurer's Report, but I prefer the lower figure as more truly balancing income versus expenditures for the first 9 months of 1999.

Action is required on the Proposed Budget for 2000, presented on the pumpkin yellow pages. It is essentially a repetition of that for 1999, a deficit budget for the fourth successive year. We have been spared from actually operating in the red for 2 previous years by the absence of the bill for printing the journal. This is $14,000, essentially the amount of the potential deficit each year.

I am recommending acceptance of the Treasurer's Proposed Budget because I don't know what else to do at the present time. However, I want a strong caveat that we resolve the matter of the printing bill. Since the journal is done by the Auburn University Press, the $14,000 could be considered a supportive gift from Auburn, but no request for acknowledgment has ever been made. Since the State of Alabama forbids any of its agencies to operate on a deficiency, I think it is inappropriate for the Academy to appear to do so.

What I am proposing is a nuisance, since it would be much easier just to coast along, as we have done. My conscience tells me we need a resolution.

3. Membership--position vacant--No Report

4. Research--Anne M. Cusic presented the following written report.

The Chairperson of the Committee on Research received only 10 requests for application materials related to the Student Research Award Competition, Student Research Grants, and Student Travel Awards. The majority of students went directly to the web page for the application materials. Seventeen students applied for Travel Grants. Sixteen were awarded with one student withdrawing her application. Nineteen students submitted completed applications for entering the Student Research Awards competition. One student withdrew from the competition, thus 18 students competed for awards in 5 Sections of the Academy. All students entered the paper competitions. No student entered the poster competitions. There were 7 applications for Student Research Grants. Attached is a list of the winners of the various awards for 1999.

At the annual meeting of the Academy in 1999, the Committee on Research addressed the possibility of giving two awards for papers if no student entered the poster competition in a current Section. The Committee voted not to change the current rules. The committee members felt that

both paper and poster competition should be encouraged. If the Executive Committee has no objections, the Committee on Research will continue to give one Student Research Award for paper and one for poster in each Section of the Academy.

I have requested that the web site developed by Dr. Richard Hudiburg which contains the eligibility requirements and the application forms for the Student Awards be included on this year's Call for Papers. The address is http://www2.una.edu/psychology/aaspage.htm .

Last year three main problems arose concerning the students' application for the award competition. The first was meeting the deadlines. The deadline for receiving applications this year will be February 2, 2000. Applications will not be accepted after this date. The second problem was that several students were not members of the Academy when they applied for the competition. These students were informed that this was a requirement. They were given the opportunity to apply, yet several had not become members by the annual meeting. This year, if a student is not a member at the time his or her application is received, the student will be given a deadline by which time he or she must have paid the dues. If this is not done, the student will be withdrawn from the competition. The last problem is that several students competing for the Student Research Award Competition did not register for the meeting, a requirement for the award. All of these problems resulted in numerous telephone calls, e-mails and personal communications which would be unnecessary if the students followed the eligibility requirements that were sent to every applicant.

Please encourage your students to participate in the award competitions of the AAS. Please communicate to interested students that the application deadline for the 2000 meeting is February 2. Please advise your students that they must meet the eligibility requirements for the awards at the time their application is received by the Chairperson of the Committee.

Student Research Awards

Section I Biological Sciences		
Michael C.L. Vickery	UAB	$50
Section II Chemistry		
Eric Johnson	UAB	$50
Section IV Geography, Forestry, Conservation and Planning		
Michael Wall	Auburn	$50
Section VIII Behavioral and Social Sciences		
Irena Pashaj	University of North Alabama	$50
Section X Engineering and Computer Science		
Co-winners		
Lara Francis	UAB	$25
Lakshminarayanan Venkatasubramanian	UAB	$25

Student Research Grants

Name	Affiliation	Section	Advisor	Amount
Jeffrey Carroll	UAB	Biology	Bej	$250
Hugh Hammer	UAB	Biology	Watts	$125
Michael Myers	UAB	Biology	Bej	$245
Mickie Powell	UAB	Biology	Watts	$125
Joseph F. Tolar	UAB	Biology	Angus	$250
Michael C. Vickery	UAB	Biology	Amsler	$240

Michael A. Wall	Auburn	Biology	Boyd	$244

Student Travel Grants

Name	Affiliation	Award
Lujia Bu	UAB	$35
Jeffrey Carroll	UAB	$35
Lara Francis	UAB	$35
Stephen Greer	UAB	$35
Hugh Hammer	UAB	$35
Michael Myers	UAB	$35
Irena Pashaj	Univ. of North Alabama	$30
Mickie Powell	UAB	$35
Craig Rowell	UAB	$35
Madhanraj Selvaraj	UAB	$35
Tao Tao	UAB	$35
Joseph Tolar	UAB	$35
Morgan Varner	Auburn	$50
Lakshminarayanan Venkatasubramenian	UAB	$35
Michael Vickery	UAB	$35

5. Long-Range Planning--Ken Marion, chair--No report

6. Auditing--Sr. Academy--Denny Bearce, chair--No report

7. Auditing--Jr. Academy--Danice H. Costes submitted the following written report.

This is a report of the Alabama Junior Academy of Science Auditing Committee for the July 1998-July 1999 financial year. We have examined the books provided by the Alabama Junior Academy of Science Treasurer, Dr. B.J. Bateman. We are satisfied ourselves that the receipts and expenditures, as presented to us, are correct and that all expenditures are legitimate expenses.

The net worth as of June 30, 1999 is $17,392.34.

8. Editorial Board and Associate Journal Editors--Douglas Watson/Larry Wit/Bill Osterhoff, co-chairs--No report

9. Place and Date of Meeting--Thomas Bilbo submitted the following written report.

Plans for future:

Annual Meeting	Location	Local Arrangements Chairperson
2000 March 29-April 1	Samford University Birmingham, AL 35229	Dr. LarryDavenport
2001	Auburn University Auburn, AL 36849	

2002 March 20-23	University of West AL Station 7 Livingston, AL 35470	Dr. Richard Holland
2003	Jacksonville State Univ 700 Pelham Road North Jacksonville, AL 36265	Dr. Frank Romano

10. Newsletter--Lynn Stover/Tom Jandebeur, co-chairs--No report

11. Public Relations--Myra Smith, chair--No report

12. Archives--Troy L. Best submitted the following written report.

We still need to obtain photographs (especially of members of the Executive Committee), committee reports, minutes of the AAS Executive Committee meetings, etc.

If you have items that you believe may be worthy of inclusion in the AAES Archives, please send them to me or to Dr. Dwayne Cox, the archivist in charge of AAS materials at the Auburn University Ralph B. Draughon Library.

Again, I encourage all officers and members of the AAS to donate significant documents, photographs, etc. to the archives.

13. Science and Public Policy--Dail Mullins reported that Alabama is the only state in the union that did not purchase "Teaching About Evolution and the Nature of Science" and send the book to their life science teachers. The NAS donated 800 books to Alabama. It will cost $1,500 to mail the books to science teachers. Bradley made a motion to support this mailing with $500. Following a second by Davenport and a call for the question by Moeller, the motion passed unanimously.

14. Gardner Award--Ellen McLaughlin submitted the following written report.

1. We have two nominees for the Gardner Award.

The Alabama Academy of Science established the Wright A. Gardner Award in 1984 to honor individuals making outstanding contributions to science while in residence in Alabama. Dr. Gardner was the principal founder and first president of the Alabama Academy of Science established in 1924. Recent recipients have included individuals from academia, industry and the health professions. They are honored at the Spring meeting of the Academy. A Biological sketch of Dr. Gardner and a description of the award can be viewed on the AAS Home Page at Athens State University. http://www.athens.edu/sos/aas/garbio.htm and http://www.athens.edu/sos/aas/gardawd.htm

2. A call for further nominations will be advertised in the Fall Alabama

3. Academy of Science Newsletter and nominations will be due by January 7, 2000.

My mailing address is: Dr. Ellen W. McLaughlin
Biology Department
Samford University
Birmingham, AL 35229
Office 726-2845 Home 595-0806
e-mail ewmclaug@samford.edu

15. Carmichael Award--Bill Boardman submitted the following written report.

The committee presented its annual award for the outstanding paper published in the *JAAS* during the previous year to Gayle Christopher and C.A. Sundermann, Department of Zoology and Wildlife Sciences, Auburn University. The title of their paper is: "Probing the Genome of *Tetrahymena Pyriformis* for an Insulin Receptor Tyrosine Kinase Homologous Sequence".

16. Resolutions--position vacant--No report

17. Nominating Committee--Roland Dute, chair--No report

18. Mason Scholarship--Michael Moeller submitted the following written report.

Last year we had six completed applications for the William H. Mason Scholarship. After reviewing all application materials, the scholarship committee voted to offer the $1,000 award to Ruth Borden, and Ms. Borden has accepted the scholarship.

The committee plans to send an announcement soon to deans in schools of science and education within Alabama. Members of the AAS Executive Committee are encouraged to disseminate information about the Scholarship.

The previous recipients of the William H. Mason Scholarship are:

1990-91	Amy Livengood Sumner
1991-92	Leela Shook Holt
1992-93	Joni Justice Shankles
1993-94	Jeffrey Baumback
1994-95	(Not awarded)
1995-96	Laura W. Cochran
1996-97	Tina Anne Beams
1997-98	Carole Collins Clegg
1998-99	Cynthia Ann Phillips
1999-2000	Ruth Border

19. Gorgas Scholarship Program--Ellen Buchner reported that committee members are needed to work on the Gorgas Scholarship Program.

Dr. Barker made the motion to approve the reports with the change in the treasurer's report. The motion was seconded by Dr. Moeller and passed following a formal vote.

D. Old Business -- None

E. New Business--Dr. Bradley asked how to change and add new sections. Dr. Buckner suggested that a meaningful way is by incorporating the new areas into the current sections.

F. Adjournment--the meeting adjourned at 11:50 a.m.

Respectfully submitted,

Priscilla Holland, Secretary
Alabama Academy of Science

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INSTRUCTIONS TO AUTHORS

Editorial Policy: Publication of the *Journal of the Alabama Academy of Science* is restricted to members. Membership application forms can be obtained from Dr. A. Priscilla Holland, Office of Research, UNA Box 5121, University of North Alabama, Florence, AL 35632-0001. Subject matter should address original research in one of the discipline sections of the Academy: Biological Sciences; Chemistry; Geology: Forestry, Geography, Conservation, and Planning; Physics and Mathematics; Industry and Economics, Science Education; Social Sciences; Health Sciences; Engineering and Computer Science; and Anthropology. Timely review articles of exceptional quality and general readership interest will also be considered. Invited articles dealing with Science Activities in Alabama are occasionally published. Book reviews of Alabama authors are also solicited. Submission of an article for publication in the implies that it has not been published previously and that it not currently being considered for publication elsewhere. Each manuscript will receive at least two simultaneous peer reviews.

Submission: Submit an original and two copies to the editor. Papers which are unreasonably long and verbose, such as uncut theses, will be returned. The title page should contain the author's name, affiliation, and address, including zip code. The editor may request that manuscripts be submitted on a diskette upon their revision or acceptance.

Manuscripts: Consult recent issues of the *Journal* for format. Double-space manuscripts throughout, allowing 1-inch margins. Number all pages. An abstract not exceeding 200 words will be published if the author so desires. Use heading and subdivisions where necessary for clarity. Common headings are: **Introduction** (including literature review), **Procedures** (or **Materials and Methods**), **Results, Discussion,** and **Literature Cited.** Other formats may be more appropriate for certain subject matter areas. Headings should be in all caps and centered on the typed page; sub-headings should be italicized (underlined) and placed at the margin. Avoid excessive use of footnotes. No not use the number 1 for footnotes; begin with 2. Skip additional footnote numbers if one or more authors must have their present address footnoted.

Illustrations: Submit original inked drawings (graphs and diagrams) or clear black and white glossy photographs. Width must not exceed 15 cm and height must not exceed 20 cm. Illustrations not conforming to these dimensions will be returned to the author. Use lettering that will still be legible after a 30% reduction. Designate all illustrations as figures, number consecutively, and cite all figures in the text. Type figure captions on a separate sheet of paper. Send two extra sets of illustrations; xeroxed photographs are satisfactory for review purposes.

Tables: Place each table on a separate sheet. Place a table title directly above each table. Number tables consecutively. Use symbols or letters, not numerals, for table footnotes. Cite all tables in the text.

Literature Cited: Only references cited in the text should be listed under **Literature Cited.** Do not group references according to source (books, periodicals, newspapers, etc.). List in alphabetical order of senior author names. Cite references in the text parenthetically by author-date.